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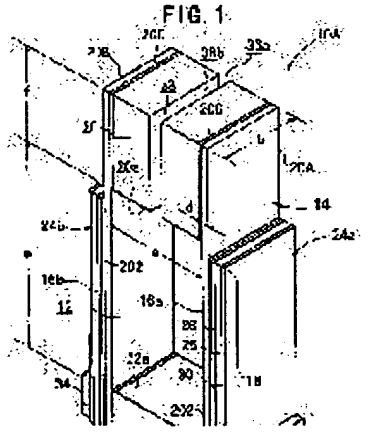
(54) PIEZOELECTRIC/ELECTROSTRICTIVE DEVICE AND MANUFACTURING METHOD THEREOF

(57)Abstract:

PROBLEM TO BE SOLVED: To attain longer life of a device, increased displacement at a movable part, and faster speed (higher resonance frequency) while handling characteristics of the device, fitting characteristics of a part to the movable part, and fitting characteristics of the device are improved.

SOLUTION: There are provided a pair of facing thin plates 16a and 16b, a movable part 20, and a fixing part 22 for supporting them. Any one of the pair of thin plates 16a and 16b is provided with piezoelectric/electrostrictive elements 24a and 24b. Related to a piezoelectric/electrostrictive device 10A where a hole 12 is formed of both

FIG. 1



inside walls of the pair of thin plates 16a and 16b, an inside wall 20a of the movable part 20, and an inside wall 22a of the fixing part 22, the pair of thin plates 16a and 16b is made of metal.

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* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

CLAIMS

[Claim(s)]
[Claim 1] They are the piezo-electricity / electrostriction device which has at least the actuator section which laminating mold piezo-electricity / electrostriction component fixed through adhesives on the metal sheet metal section, and is characterized by the actuator film with which said laminating mold piezo-electricity / electrostriction component consist of piezo-electricity / an electrostriction layer, and an electrode layer consisting of multilayer objects of at least three or more layers.
[Claim 2] The piezo-electricity / electrostriction device which the laminating of two or more electrode layers in the multilayer object which constitutes said piezo-electricity / electrostriction component is alternately carried out in piezo-electricity / electrostriction device according to claim 1, and is characterized by connecting so that the same electrical potential difference may be impressed every other layer.
[Claim 3] The piezo-electricity / electrostriction device characterized by said actuator film consisting of multilayer objects of ten or less layers in piezo-electricity / electrostriction device according to claim 1 or 2.
[Claim 4] The piezo-electricity / electrostriction device characterized by forming said actuator film with the printing multilayer method in piezo-electricity / electrostriction device given in any 1 term of claims 1-3.
[Claim 5] The piezo-electricity / electrostriction device characterized by a location gap of the direction of a field in the perpendicular plane of projection of said electrode layer in every other layer being 50 micrometers or less in piezo-electricity / electrostriction device given in any 1 term of claims 1-4.
[Claim 6] The piezo-electricity / electrostriction device characterized by the thickness of said adhesives being 15 micrometers or less in piezo-electricity / electrostriction device given in any 1 term of claims 1-5.
[Claim 7] The piezo-electricity / electrostriction device characterized by forming the substrate layer in an opposed face with said sheet metal section in said piezo-electricity / electrostriction component in piezo-electricity / electrostriction device given in any 1 term of claims 1-6.
[Claim 8] The piezo-electricity / electrostriction device characterized by forming one or more holes or a hole in the part in which said piezo-electricity / electrostriction component are formed at least among said sheet metal sections in piezo-electricity / electrostriction device given in any 1 term of claims 1-7.
[Claim 9] The piezo-electricity / electrostriction device characterized by making into a split face the part in which said piezo-electricity / electrostriction component are formed at least among the front faces of said sheet metal section in piezo-electricity / electrostriction device given in any 1 term of claims 1-7.
[Claim 10] It consists of the metal sheet metal section of the pair which carries out phase opposite, and a fixed part which supports these sheet metal section. The actuator section by which laminating mold piezo-electricity / electrostriction component was fixed through adhesives on one [at least] sheet metal section is provided. Said laminating mold piezo-electricity / electrostriction component Consist of two or more piezo-electricity / electrostriction layers, and electrode layers, and the electrode layer which touches the vertical side of each piezo-electricity / electrostriction layer is alternately drawn by the opposite end face. The piezo-electricity / electrostriction device characterized by connecting electrically the end-face electrode which connects electrically each electrode layer drawn by the alternate opposite end face concerned to the terminal area which only predetermined distance leaves, and by which it was prepared in the front face of said piezo-electricity / electrostriction layer of the outermost layer, and it has been arranged, respectively.
[Claim 11] They are the piezo-electricity / electrostriction device characterized by said laminating mold piezo-electricity / electrostriction component presenting the rectangular parallelepiped configuration mostly in piezo-electricity / electrostriction device according to claim 10.
[Claim 12] They are the piezo-electricity / electrostriction device characterized by the predetermined distance between said terminal areas being 50 micrometers or more in piezo-electricity / electrostriction device according to claim 10 or

11.

[Claim 13] The piezo-electricity / electrostriction device characterized by connecting electrically said one [at least] terminal area and said one end-face electrode by the electrode layer of thickness thinner than these terminal areas and an end-face electrode in piezo-electricity / electrostriction device given in any 1 term of claims 10-12.

[Claim 14] The sheet metal section of the pair which carries out phase opposite, and the fixed part which supports these sheet metal section are provided. They are the piezo-electricity / electrostriction device with which one or more piezo-electricity / electrostriction components were arranged in at least one sheet metal section among the sheet metal sections of said pair. The minimum resonance frequency of the structure in case the body of comparable magnitude intervenes substantially with said fixed part between the open ends of the sheet metal section of said pair is 20kHz or more. The piezo-electricity / electrostriction device with which the amount of relative displacements of said body and said fixed part is characterized by being 0.5 micrometers or more in ontic applied-voltage 30V on 1/4 or less frequency of said resonance frequency.

[Claim 15] The piezo-electricity / electrostriction device which adhesives intervene between said piezo-electricity / electrostriction components, and said sheet metal sections, and is characterized by the thickness of said adhesives being 10% or less of thickness of the thickness of said piezo-electricity / electrostriction component in piezo-electricity / electrostriction device according to claim 14.

[Claim 16] The piezo-electricity / electrostriction device with which said one or more piezo-electricity / electrostriction components are arranged in one sheet metal section among the sheet metal sections of said pair, and thickness of one [said] sheet metal section is characterized by being thicker than the thickness of the sheet metal section of another side in piezo-electricity / electrostriction device according to claim 14 or 15.

[Claim 17] In piezo-electricity / electrostriction device given in any 1 term of claims 14-16 When a body intervenes between the open ends in the sheet metal section of said pair, the distance between the boundary parts of a boundary part with said body in the sheet metal section of said pair and said fixed part 0.4mm or more, The piezo-electricity / electrostriction device characterized by being 2mm or less and each thickness of the sheet metal section of said pair being 10 micrometers or more and 100 micrometers or less.

[Claim 18] They are the piezo-electricity / electrostriction device characterized by the actuator film with which said piezo-electricity / electrostriction component consist of piezo-electricity / an electrostriction layer, and an electrode layer in piezo-electricity / electrostriction device given in any 1 term of claims 14-17 consisting of multilayer objects of at least three or more layers.

[Claim 19] The piezo-electricity / electrostriction device characterized by said actuator film consisting of multilayer objects of ten or less layers in piezo-electricity / electrostriction device according to claim 18.

[Claim 20] The piezo-electricity / electrostriction device characterized by the thickness of said piezo-electricity / electrostriction layer being 5 micrometers or more and 30 micrometers or less in piezo-electricity / electrostriction device according to claim 18 or 19.

[Claim 21] The piezo-electricity / electrostriction device characterized by the thickness of the electrode layer inserted into said piezo-electricity / electrostriction layer at least being 0.5 micrometers or more and 20 micrometers or less in piezo-electricity / electrostriction device given in any 1 term of claims 18-20.

[Claim 22] The piezo-electricity / electrostriction device which the laminating of two or more electrode layers in the multilayer object which constitutes said piezo-electricity / electrostriction component is carried out alternately, and is characterized by connecting so that the same electrical potential difference may be impressed every other layer in piezo-electricity / electrostriction device given in any 1 term of claims 18-21.

[Claim 23] They are the piezo-electricity / electrostriction device characterized by being formed so that the electrode layer of the layer [1st] piezo-electricity / the electrostriction layer, or the 1st layer, and the layer [1st] piezo-electricity / electrostriction layer may contact said sheet metal section among the multilayer objects with which said piezo-electricity / electrostriction component constitute this piezo-electricity / electrostriction component in piezo-electricity / electrostriction device according to claim 22.

[Claim 24] They are the piezo-electricity / electrostriction device characterized by forming one side in the location which does not contain said fixed part at least superficially among the edges of said electrode layer in piezo-electricity / electrostriction device according to claim 22 or 23.

[Claim 25] The piezo-electricity / electrostriction device with which the end of the multilayer object which constitutes said piezo-electricity / electrostriction component is characterized by being formed in the location which does not contain said fixed part at least superficially in piezo-electricity / electrostriction device given in any 1 term of claims 18-24.

[Claim 26] In piezo-electricity / electrostriction device according to claim 24 or 25, when a body intervenes between the

open ends in the sheet metal section of said pair The minimum distance between the boundary parts of a boundary part with said body in the sheet metal section of said pair and said fixed part is set to La. When the multilayer object which constitutes said piezo-electricity / electrostriction component among said body or said fixed part is not formed with while and sets shortest distance to Lb among the distance from a boundary part with said sheet metal section to the edge of said electrode layer, The piezo-electricity / electrostriction device characterized by (1-Lb/La) being 0.4 or more.
[Claim 27] The piezo-electricity / electrostriction device characterized by (1-Lb/La) being 0.5-0.8 in piezo-electricity / electrostriction device according to claim 26.
[Claim 28] The piezo-electricity / electrostriction device characterized by said sheet metal section becoming any 1 term of claims 14-27 from a metal in the piezo-electricity / electrostriction device of a publication.
[Claim 29] The piezo-electricity / electrostriction device characterized by consisting of a metal plate with which cold rolling processing of said sheet metal section was carried out in piezo-electricity / electrostriction device according to claim 28.
[Claim 30] The piezo-electricity / electrostriction device with which thickness is characterized by adhesives (0.1 micrometers or more and 30 micrometers or less) intervening in piezo-electricity / electrostriction device given in any 1 term of claims 18-29 between said multilayer object which constitutes said piezo-electricity / electrostriction component, and said sheet metal section.
[Claim 31] The piezo-electricity / electrostriction device characterized by said adhesives consisting of organic resin in piezo-electricity / electrostriction device according to claim 30.
[Claim 32] The piezo-electricity / electrostriction device characterized by said adhesives consisting of glass, low material, or solder in piezo-electricity / electrostriction device according to claim 30.
[Claim 33] The piezo-electricity / electrostriction device characterized by forming the substrate layer in an opposed face with said sheet metal section in said multilayer object in piezo-electricity / electrostriction device given in any 1 term of claims 30-32.
[Claim 34] The piezo-electricity / electrostriction device characterized by forming one or more holes or a hole in the part in which said multilayer object is formed at least among said sheet metal sections in piezo-electricity / electrostriction device given in any 1 term of claims 30-33.
[Claim 35] The piezo-electricity / electrostriction device characterized by making into a split face the part in which said multilayer object is formed at least among the front faces of said sheet metal section in piezo-electricity / electrostriction device given in any 1 term of claims 30-33.
[Claim 36] The piezo-electricity / electrostriction device characterized by adhesives (0.1 micrometers or more and 30 micrometers or less) intervening [thickness] between said fixed parts at least with said sheet metal section in piezo-electricity / electrostriction device given in any 1 term of claims 14-35.
[Claim 37] The piezo-electricity / electrostriction device characterized by said adhesives consisting of organic resin in piezo-electricity / electrostriction device according to claim 36.
[Claim 38] The piezo-electricity / electrostriction device characterized by said adhesives consisting of glass, low material, or solder in piezo-electricity / electrostriction device according to claim 36.
[Claim 39] The piezo-electricity / electrostriction device characterized by giving curvature to the flash configuration of said adhesives which overflowed the opposite part with said fixed part into any 1 term of claims 36-38 at least with said sheet metal section in the piezo-electricity / electrostriction device of a publication.
[Claim 40] The piezo-electricity / electrostriction device characterized by beveling the corner which counters said body of said fixed part at least in piezo-electricity / electrostriction device given in any 1 term of claims 36-38 when a body intervenes between the open ends in the sheet metal section of said pair.
[Claim 41] The piezo-electricity / electrostriction device characterized by turning the burr by said blanking processing to the method of outside in piezo-electricity / electrostriction device given in any 1 term of claims 36-38 when said sheet metal section is produced by blanking processing of a metal plate.
[Claim 42] The sheet metal section of the pair which carries out phase opposite, and the fixed part which supports these sheet metal section are provided. Two or more sheet metal which is the manufacture approach of piezo-electricity / electrostriction device that one or more piezo-electricity / electrostriction components were arranged in at least one sheet metal section among the sheet metal sections of said pair, and forms the sheet metal section behind at least, Said piezo-electricity / electrostriction component, the process for which a support substrate is prepared, and the process which fixes piezo-electricity / electrostriction component through the 1st adhesives to said at least one sheet metal, The process which produces the device original recording which fixes said two or more sheet metal through the 2nd adhesives to said support substrate, and by which phase opposite of this two or more sheet metal was carried out, The manufacture approach of of the piezo-electricity / electrostriction device characterized by having the separation process

which divides said device original recording into plurality, and produces each piezo-electricity / electrostriction device of said.

[Claim 43] The sheet metal section of the pair which carries out phase opposite, and the fixed part which supports these sheet metal section are provided. Two or more sheet metal which is the manufacture approach of piezo-electricity / electrostriction device that one or more piezo-electricity / electrostriction components were arranged in at least one sheet metal section among the sheet metal sections of said pair, and forms the sheet metal section behind at least, Said piezo-electricity / electrostriction component, the process for which a support substrate is prepared, and the process which fixes said two or more sheet metal through the 2nd adhesives to said support substrate, The process which produces the device original recording which fixes piezo-electricity / electrostriction component through the 1st adhesives to said at least one sheet metal, and by which phase opposite of said two or more sheet metal was carried out, The manufacture approach of of the piezo-electricity / electrostriction device characterized by having the separation process which divides said device original recording into plurality, and produces each piezo-electricity / electrostriction device of said.

[Claim 44] It is the manufacture approach of of the piezo-electricity / electrostriction device characterized by said support substrate being the cyclic structure object of the rectangle which has the part which serves as said body at least behind, and the part which serves as said fixed part behind when a body intervenes in the manufacture approach of of piezo-electricity / electrostriction device according to claim 42 or 43 between the open ends in the sheet metal section of said pair of the piezo-electricity / electrostriction device produced.

[Claim 45] It is the manufacture approach of the piezo-electricity / electrostriction device characterized by for said support substrate to be the cyclic structure object of the rectangle which has the part which supports said open end, and the part which serves as said fixed part behind when a body does not intervene between the open ends in the sheet metal section of said pair of the piezo-electricity / electrostriction device produced in the manufacture approach of of piezo-electricity / electrostriction device given in any 1 term of claims 42-44.

[Claim 46] The manufacture approach of of the piezo-electricity / electrostriction device characterized by said the 1st adhesives and/or 2nd adhesives being organic resin in the manufacture approach of of piezo-electricity / electrostriction device given in any 1 term of claims 42-45.

[Claim 47] The manufacture approach of of the piezo-electricity / electrostriction device characterized by said the 1st adhesives and/or 2nd adhesives being glass, low material, or solder in the manufacture approach of of piezo-electricity / electrostriction device given in any 1 term of claims 42-45.

[Claim 48] The manufacture approach of of the piezo-electricity / electrostriction device characterized by said sheet metal and/or a support substrate being metals in the manufacture approach of of piezo-electricity / electrostriction device given in any 1 term of claims 42-47.

[Claim 49] The manufacture approach of of the piezo-electricity / electrostriction device characterized by said cutting direction being almost the same as the displacement direction of the sheet metal section of said pair when it includes the processing cut along with a predetermined cutting plane line to said device original recording as processing which divides said device original recording into any 1 term of claims 42-48 in the manufacture approach of of the piezo-electricity / electrostriction device of a publication.

[Claim 50] The manufacture approach of of the piezo-electricity / electrostriction device characterized by including the process which forms a substrate layer in an opposed face with said sheet metal in said piezo-electricity / electrostriction component in the manufacture approach of of piezo-electricity / electrostriction device given in any 1 term of claims 42-49 before fixing said piezo-electricity / electrostriction component through said 1st adhesives to said sheet metal.

[Claim 51] The manufacture approach of of the piezo-electricity / electrostriction device characterized by including the process which forms one or more holes or a hole in the part which said piezo-electricity / electrostriction component fix at least among said sheet metal in the manufacture approach of of piezo-electricity / electrostriction device given in any 1 term of claims 42-50.

[Claim 52] The manufacture approach of of the piezo-electricity / electrostriction device characterized by including the process which makes coarse the part which said piezo-electricity / electrostriction component fix at least among the front faces of said sheet metal in the manufacture approach of of piezo-electricity / electrostriction device given in any 1 term of claims 42-50.

[Claim 53] The manufacture approach of of the piezo-electricity / electrostriction device characterized by including the process which forms curvature in the flash configuration of said 2nd adhesives which overflowed the opposite part of said sheet metal and said support substrate into any 1 term of claims 42-52 in the manufacture approach of of the piezo-electricity / electrostriction device of a publication.

[Claim 54] The manufacture approach of of the piezo-electricity / electrostriction device characterized by including the

process which bevels the corner which counters mutually [said support substrate] among said device original recording any 1 term of claims 42-52 in the manufacture approach of of the piezo-electricity / electrostriction device of a publication.

[Claim 55] In piezo-electricity / electrostriction device given in any 1 term of claims 42-52 When it includes the process which produces said sheet metal by processing it by piercing to a metal plate The manufacture approach of of the piezo-electricity / electrostriction device characterized by turning to the method of outside the burr by said blanking processing which has generated said sheet metal in said sheet metal in case said device original recording is produced combining said support substrate, and producing said device original recording.

[Translation done.]

* NOTICES *

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] About piezo-electricity / electrostriction device equipped with the moving part which operates based on displacement actuation of piezo-electricity / electrostriction component or the piezo-electricity / electrostriction device which can detect the variation rate of moving part by piezo-electricity / electrostriction component, and its manufacture approach, in detail, this invention is excellent in reinforcement, shock resistance, and moisture resistance, and relates to the piezo-electricity / electrostriction device which can operate moving part greatly efficiently, and its manufacture approach.
[0002]
[Description of the Prior Art] Recently, in fields, such as optics, and magnetic recording, precision processing, the displacement component which can adjust the optical path length and a location is needed to submicron order, and development of the displacement component using the variation rate by the inverse piezoelectric effect and electrostrictive effect which are caused when an electrical potential difference is impressed to piezo-electricity / electrostriction ingredients (for example, ferroelectric etc.) is furthered.
[0003] Conventionally, as such a displacement component, as shown, for example in drawing 53 , by forming a pore 402 in the plate 400 which consists of piezo-electricity / an electrostriction ingredient, a fixed part 404, moving part 406, and the beam section 408 that supports these are formed in one, and the electrostrictive actuator which formed the electrode layer 410 in the beam section 408 is indicated further (for example, refer to JP,10-136665,A).
[0004] In said electrostrictive actuator, if an electrical potential difference is impressed to the electrode layer 410, it is possible at least for an arc status change to carry out the rotation variation rate of the moving part 406 into the field of a plate 400 according to an inverse piezoelectric effect or an electrostrictive effect, since the beam section 408 expands and contracts in the direction which connects a fixed part 404 and moving part 406.
[0005] The technique of performing highly precise positioning at a high speed is indicated, and the structure used making the bimorph of two sheets counter is shown to this official report (especially Fig. 4) by by dividing the electrode of that bimorph, preparing, and on the other hand, choosing and driving the divided electrode about the actuator which used bimorph for JP,63-64640,A.
[0006]
[Problem(s) to be Solved by the Invention] However, in said electrostrictive actuator, since the variation rate of the flexible direction (namely, field inboard of a plate 400) of piezo-electricity / electrostriction ingredient was transmitted to moving part 406 as it was, there was a problem that the travel of moving part 406 was small.
[0007] Moreover, since it constituted all parts with the piezo-electricity / electrostriction ingredient which is a brittle and comparatively heavy ingredient, the mechanical strength of the electrostrictive actuator was low, in addition to being inferior to handling nature, shock resistance, and moisture resistance, its electrostrictive actuator itself was heavy, and it had the trouble of being easy to be influenced on actuation of a harmful vibration (for example, residual vibration and noise vibration at the time of a fast operation).
[0008] In order to solve said trouble, filling up a pore 402 with the filler which has flexibility is proposed, but it is distinct that the amount of the variation rate by the inverse piezoelectric effect or the electrostrictive effect falls only by using a filler.
[0009] This invention is made in consideration of such a technical problem, and can raise the attachment nature of the components to moving part, or the stability of a device in the reinforcement of a device, and the handling nature list of a device. By this While being able to displace moving part greatly by the low battery relatively, can make improvement in the speed (raise in resonance frequency) of a device, especially displacement actuation of moving part attain, moreover,

are hard to be influenced of a harmful vibration, and a high-speed response is possible. A mechanical strength is high and it aims at offering the piezo-electricity / electrostriction device which can obtain the displacement component excellent in handling nature, shock resistance, and moisture resistance, and the sensor component which can detect vibration of moving part with a sufficient precision in a list, and its manufacture approach.

[0010]

[Means for Solving the Problem] This invention has at least the actuator section which laminating mold piezo-electricity / electrostriction component fixed through adhesives on the metal sheet metal section, and said laminating mold piezo-electricity / electrostriction component are characterized by the actuator film which consists of piezo-electricity / an electrostriction layer, and an electrode layer consisting of multilayer objects of at least three or more layers.

[0011] Thereby, even if it does not extend the area on the flat surface of laminating mold piezo-electricity / electrostriction component, the variation rate of the sheet metal section can be carried out greatly, and moreover, since the sheet metal section is metal, it excels in reinforcement or toughness and can respond also to rapid displacement actuation.

[0012] That is, in this invention, it can fully respond also in fluctuation and the severe busy condition of an operating environment. While being able to excel in shock resistance, being able to aim at improvement in the reinforcement of piezo-electricity / electrostriction device, and the handling nature of piezo-electricity / electrostriction device and being able to carry out the variation rate of the sheet metal section greatly by the low battery relatively moreover The rigidity of the sheet metal section is high, and the thickness of the actuator film is thick, and since rigidity is high, improvement in the speed (raise in resonance frequency) of displacement actuation of the sheet metal section can be made to attain.

[0013] And it is desirable to connect so that a laminating may be carried out so that two or more electrode layers in the multilayer object which constitutes said piezo-electricity / electrostriction component may have an alternate end face, and the same electrical potential difference may be impressed every other layer. Moreover, as for said actuator film, it is desirable to consist of multilayer objects of ten or less layers, and, as for said actuator film, being formed with the printing multilayer method is desirable. Furthermore, it is desirable that a location gap of the direction of a field in the perpendicular plane of projection of said electrode layer in every other layer is 50 micrometers or less, and, as for the thickness of said adhesives, it is desirable that it is 15 micrometers or less.

[0014] You may make it this invention form a substrate layer in an opposed face with said sheet metal section in said piezo-electricity / electrostriction component. Moreover, you may make it form one or more holes or a hole in the part in which said piezo-electricity / electrostriction component are formed at least among said sheet metal sections. In this case, since adhesives enter in a hole or a hole, while adhesion area becomes large substantially, it becomes possible to make thickness of adhesives thin. Furthermore, it is good also considering the part in which said piezo-electricity / electrostriction component are formed at least among the front faces of said sheet metal section as a split face. In this case, since adhesion area becomes large substantially, adhesion can be strengthened.

[0015] Moreover, this invention consists of the metal sheet metal section of the pair which carries out phase opposite, and a fixed part which supports these sheet metal section. The actuator section by which laminating mold piezo-electricity / electrostriction component was fixed through adhesives on one [at least] sheet metal section is provided. Said laminating mold piezo-electricity / electrostriction component Consist of two or more piezo-electricity / electrostriction layers, and electrode layers, and the electrode layer which touches the vertical side of each piezo-electricity / electrostriction layer is alternately drawn by the opposite end face. The end-face electrode which connects electrically each electrode layer drawn by the alternate opposite end face concerned is prepared in the front face of said piezo-electricity / electrostriction layer of the outermost layer, and is characterized by connecting with the terminal area which only predetermined distance leaves and by which it has been arranged electrically, respectively. Drawing of a detection signal can be easily performed in the supply list of a driving signal to the laminated piezo-electricity / electrostriction component by this, and formation of the laminating mold piezo-electricity / electrostriction component to the sheet metal section can be realized.

[0016] And you may make it present a rectangular parallelepiped configuration for said laminating mold piezo-electricity / electrostriction component mostly in this invention. In this case, as for the predetermined distance between said terminal areas, it is desirable that it is 50 micrometers or more. Moreover, you may make it connect electrically said one [at least] terminal area and said one end-face electrode by the electrode layer of thickness thinner than these terminal areas and an end-face electrode.

[0017] Moreover, this invention possesses the sheet metal section of the pair which carries out phase opposite, and the fixed part which supports these sheet metal section. They are the piezo-electricity / electrostriction device with which one or more piezo-electricity / electrostriction components were arranged in at least one sheet metal section among the

sheet metal sections of said pair. The minimum resonance frequency of the structure in case the body of comparable magnitude intervenes substantially with said fixed part between the open ends of the sheet metal section of said pair is 20kHz or more. The amount of relative displacements of said body and said fixed part is characterized by being 0.5 micrometers or more in ontic applied-voltage 30V on 1/4 or less frequency of said resonance frequency.
[0018] By this, while being able to carry out the variation rate of the sheet metal section of a pair greatly Can make improvement in the speed (raise in resonance frequency) of displacement actuation of piezo-electricity / electrostriction device, especially the sheet metal section of a pair attain, moreover, are hard to be influenced of a harmful vibration, and a high-speed response is possible. A mechanical strength is high and the displacement component excellent in handling nature, shock resistance, and moisture resistance and the sensor component which can detect vibration of moving part with a sufficient precision in a list can be obtained.
[0019] Said sheet metal section and fixed part may be constituted using the ceramics or a metal, can also constitute each part from ceramic ingredients, or can also constitute it from metallic materials. [at least] Furthermore, it can also constitute as hybrid construction which combined what was manufactured from the ceramics and a metaled ingredient.
[0020] When adhesives are made to intervene between said piezo-electricity / electrostriction components, and said sheet metal sections, it is desirable to make thickness of said adhesives into 10% or less of thickness of the thickness of said piezo-electricity / electrostriction component. Moreover, when said one or more piezo-electricity / electrostriction components are arranged in one sheet metal section among the sheet metal sections of said pair, it is desirable to make thickness of one [said] sheet metal section thicker than the thickness of the sheet metal section of another side.
[0021] And when a body intervenes between the open ends in the sheet metal section of said pair, it is desirable that the distance between the boundary parts of a boundary part with said body in the sheet metal section of said pair and said fixed part is 0.4mm or more and 2mm or less, and each thickness of the sheet metal section of said pair is 10 micrometers or more and 100 micrometers or less.
[0022] As for said piezo-electricity / electrostriction component, it is desirable that the actuator film which consists of piezo-electricity / an electrostriction layer, and an electrode layer consists of multilayer objects of at least three or more layers. In this case, as for said actuator film, it is desirable to consist of multilayer objects of ten or less layers. Moreover, it is desirable that the thickness of said piezo-electricity / electrostriction layer is 5 micrometers or more and 30 micrometers or less, and, as for the thickness of said electrode layer, it is desirable that they are 0.5 micrometers or more and 20 micrometers or less.
[0023] Moreover, it is desirable to connect so that the laminating of two or more electrode layers in the multilayer object which constitutes said piezo-electricity / electrostriction component may be carried out alternately and the same electrical potential difference may be impressed every other layer.
[0024] Especially when the sheet metal section is made into metal, said piezo-electricity / electrostriction component can prevent a different inter-electrode short pass, if it forms so that the electrode layer of the layer [1st] piezo-electricity / the electrostriction layer, or the 1st layer, and the layer [1st] piezo-electricity / electrostriction layer may contact said sheet metal section among the multilayer objects which constitute this piezo-electricity / electrostriction component.
[0025] Moreover, you may make it form one side in the location which does not contain said fixed part at least superficially among the edges of said electrode layer, and may make it form the end of the multilayer object which constitutes said piezo-electricity / electrostriction component in the location which does not contain said fixed part at least superficially.
[0026] Moreover, when a body intervenes between the open ends in the sheet metal section of said pair The minimum distance between the boundary parts of a boundary part with said body in the sheet metal section of said pair and said fixed part is set to La. When the multilayer object which constitutes said piezo-electricity / electrostriction component among said body or said fixed part is not formed with while and sets shortest distance to Lb among the distance from a boundary part with said sheet metal section to the edge of said electrode layer, It is desirable still more desirable that (1-Lb/La) is 0.4 or more, and (1-Lb/La) is 0.5-0.8.
[0027] When using said sheet metal section as a metal, it is desirable to constitute said sheet metal section from a metal plate by which cold rolling processing was carried out.
[0028] Moreover, you may make it thickness make adhesives (0.1 micrometers or more and 30 micrometers or less) intervene between said multilayer object which constitutes said piezo-electricity / electrostriction component, and said sheet metal section. In this case, said adhesives may be organic resin and may be glass, low material, or solder.
[0029] Furthermore, you may make it form a substrate layer in an opposed face with said sheet metal section in said multilayer object. Moreover, you may make it form one or more holes or a hole in the part in which said multilayer object is formed at least among said sheet metal sections. In this case, since adhesives enter in a hole or a hole, while

adhesion area becomes large substantially, it becomes possible to make thickness of adhesives thin. It is good also considering the part in which said multilayer object is formed at least among the front faces of said sheet metal section as a split face. In this case, since adhesion area becomes large substantially, adhesion can be strengthened. Furthermore, it is desirable that thickness intervenes adhesives (0.1 micrometers or more and 30 micrometers or less) between said fixed parts at least with said sheet metal section. In this case, organic resin is sufficient as said adhesives, and they may be glass, low material, or solder.

[0030] Moreover, it is desirable to give curvature to the flash configurations of said sheet metal section and said adhesives which overflowed the opposite part with said fixed part at least. In this case, since the wall of a fixed part and the wall of each sheet metal section are also used as an adhesion side, adhesion area becomes large and can enlarge bond strength. Moreover, the stress concentration for the joint (corner) of the wall of a fixed part and the wall of each sheet metal section can be distributed effectively.

[0031] When a body intervenes between the open ends in the sheet metal section of said pair, it is desirable to bevel the corner which counters said body of said fixed part at least. In this case, by adjusting the include angle and radius of curvature of beveling suitably, the amount of flashes of adhesives can be stabilized, local dispersion of bond strength can be controlled, and improvement in the yield can be aimed at. When said sheet metal section pierces and processes a metal plate and it is produced, it is desirable to turn the burr by said blanking processing to the method of outside in consideration of the adhesion direction of handling nature or each part material.

[0032] Next, this invention possesses the sheet metal section of the pair which carries out phase opposite, and the fixed part which supports these sheet metal section. Two or more sheet metal which is the manufacture approach of piezo-electricity / electrostriction device that one or more piezo-electricity / electrostriction components were arranged in at least one sheet metal section among the sheet metal sections of said pair, and forms the sheet metal section behind at least, Said piezo-electricity / electrostriction component, the process for which a support substrate is prepared, and the process which fixes piezo-electricity / electrostriction component through the 1st adhesives to said at least one sheet metal, It is characterized by fixing said two or more sheet metal through the 2nd adhesives to said support substrate, and having the process which produces the device original recording by which phase opposite of this two or more sheet metal was carried out, and the separation process which divides said device original recording into plurality, and produces each piezo-electricity / electrostriction device of said.

[0033] Moreover, this invention possesses the sheet metal section of the pair which carries out phase opposite, and the fixed part which supports these sheet metal section. Two or more sheet metal which is the manufacture approach of piezo-electricity / electrostriction device that one or more piezo-electricity / electrostriction components were arranged in at least one sheet metal section among the sheet metal sections of said pair, and forms the sheet metal section behind at least, Said piezo-electricity / electrostriction component, the process for which a support substrate is prepared, and the process which fixes said two or more sheet metal through the 2nd adhesives to said support substrate, It is characterized by having the process which produces the device original recording which fixes piezo-electricity / electrostriction component through the 1st adhesives to said at least one sheet metal, and by which phase opposite of this two or more sheet metal was carried out, and the separation process which divides said device original recording into plurality, and produces each piezo-electricity / electrostriction device of said.

[0034] By these manufacture approaches, while being able to carry out the variation rate of the sheet metal section of a pair greatly, a device, and the piezo-electricity / electrostriction device which can make improvement in the speed (raise in resonance frequency) of displacement actuation of the sheet metal section of a pair attain especially can be manufactured easily.

[0035] And when a body intervenes between the open ends in the sheet metal section of said pair of the piezo-electricity / electrostriction device produced, in the above-mentioned manufacture approach, it is good also as a cyclic structure object of the rectangle which has the part which serves as said body at least in said support substrate behind, and the part which serves as said fixed part behind.

[0036] Or when a body does not intervene between the open ends in the sheet metal section of said pair of the piezo-electricity / electrostriction device produced, in the above-mentioned manufacture approach, it is good also as a cyclic structure object of the rectangle which has the part which serves as said fixed part in said support substrate in the part (part which specifies substantially the thickness of the part between which it is behind placed by said body at least) which supports said open end, and the back.

[0037] Moreover, said the 1st adhesives and/or 2nd adhesives may be organic resin, and may be glass, low material, or solder. On the other hand, said sheet metal and/or a support substrate may be metal.

[0038] Moreover, when it includes the processing cut along with a predetermined cutting plane line as processing which separates said device original recording to said device original recording, it is desirable that said cutting direction is

almost the same as the displacement direction of the sheet metal section of said pair.
[0039] Furthermore, in the manufacture approach concerning this invention, before fixing said piezo-electricity / electrostriction component through said 1st adhesives to said sheet metal You may make it include the process which forms a substrate layer in an opposed face with said sheet metal in said piezo-electricity / electrostriction component, and may make it include the process which forms one or more holes or a hole in the part which said piezo-electricity / electrostriction component fix at least among said sheet metal.
[0040] moreover, you may make it include the process which makes coarse the part which said piezo-electricity / electrostriction component fix at least among the front faces of said sheet metal, and may make it include the process which forms curvature from the opposite part of said sheet metal and said support substrate in the flash configuration of said 2nd adhesives which saw and came out
[0041] Moreover, you may make it include the process which bevels the corner which counters mutually [said support substrate] among said device original recording. Moreover, when it includes the process which produces said sheet metal by processing it by piercing to a metal plate, the burr by said blanking processing which has generated said sheet metal in said sheet metal in case said device original recording is produced combining said support substrate is turned to the method of outside, and you may make it produce said device original recording.
[0042] Therefore, according to the piezo-electricity / electrostriction device concerning this invention, and its manufacture approach Various transducers, various actuators, a frequency-domain functional part (filter), Others [active elements /, such as a transformer, the object for a communication link, the trembler for power or a resonator, a radiator, and a discriminator,], It can use as sensor components for [various] sensors, such as an ultrasonic sensor, an acceleration sensor and an angular-velocity sensor, and an impact sensor, a mass sensor. It can use suitable for the various actuators especially used for the variation rate of various precision components, such as an optical instrument and a precision mechanical equipment, etc., or the device of positioning adjustment and include-angle adjustment.
[0043]
[Embodiment of the Invention] Hereafter, the example of a gestalt of operation of the piezo-electricity / electrostriction device concerning this invention, and its manufacture approach is explained, referring to drawing 1 - drawing 52 .
[0044] Here, piezo-electricity / electrostriction device is concepts which include the component which changes electric energy and mechanical energy mutually by piezo-electricity / electrostriction component. Therefore, it is used most suitably as active elements, such as various actuators and vibrator, and a displacement component which used the variation rate by the inverse piezoelectric effect or the electrostrictive effect especially, and also may be suitably used as passive elements, such as an acceleration-sensor component and an impact sensor component.
[0045] As shown in drawing 1 , the piezo-electricity / electrostriction device 10A concerning the gestalt of the 1st operation present the configuration of a long rectangular parallelepiped as a whole, and has the base 14 of the direction of a major axis with which the pore 12 was mostly formed in the central part.
[0046] A base 14 possesses the sheet metal sections 16a and 16b of the pair which carries out phase opposite, moving part 20, and the fixed part 22 that supports moving part 20 in sheet metal section 16a of said pair, and 16b list, and piezo-electricity / electrostriction components 24a and 24b are formed in the one section each of the sheet metal sections 16a and 16b at least, respectively.
[0047] In addition, about said base 14, although the whole was constituted using the ceramics or a metal, it is good also as hybrid construction which combined what was manufactured with the ingredient of others, the ceramics, and a metal. Moreover, the configuration of the metal integral construction which unified each part by the structure which it comes to paste up with adhesives, such as organic resin and glass, low attachment, soldering, eutectic bonding, or welding can be used for a base 14.
[0048] About the gestalt of this 1st operation, the sheet metal sections 16a and 16b of a pair are metal among bases 14, and other moving part 20 and fixed parts 22 have hybrid construction made into the product made from a ceramic. Specifically, the metal sheet metal sections 16a and 16b have fixed through adhesives 200 on each side face of the moving part 20 made from a ceramic, and a fixed part 22. Of course, the sheet metal sections 16a and 16b, moving part 20, and a fixed part 22 may be altogether made into metal.
[0049] And piezo-electricity / electrostriction components 24a and 24b will prepare piezo-electricity / electrostriction components 24a and 24b as an exception object as below-mentioned, and will be stuck on a base 14 by adhesives, such as organic resin and glass, low attachment, soldering, eutectic bonding, etc., and also they will be formed in said the direct base 14 instead of attachment by using the film forming method. On sheet metal section 16a and 16b, through adhesives 202, piezo-electricity / electrostriction components 24a and 24b fix, and consist of gestalten of the 1st operation, respectively.
[0050] Moreover, this piezo-electricity / electrostriction device 10A have the configuration which said rectangle-like

pore 12 is formed of both the walls of the sheet metal sections 16a and 16b of a pair, wall 20a of moving part 20, and wall 22a of a fixed part 22, and moving part 20 displaces by the drive of said piezo-electricity / electrostriction component 24a, and/or 24b, or detects the variation rate of moving part 20 by piezo-electricity / electrostriction component 24a, and/or 24b.

[0051] Piezo-electricity / electrostriction components 24a and 24b have piezo-electricity / electrostriction layer 26, and the electrodes 28 and 30 of the pair formed in the both sides of this piezo-electricity / electrostriction layer 26, and are constituted, and one electrode 28 is formed in the sheet metal sections 16a and 16b of a pair at least among the electrodes 28 and 30 of this pair.

[0052] Each apical surface of piezo-electricity / electrostriction layer 26 is mostly equal to the electrode 28 and 30 lists of a pair which constitute piezo-electricity / electrostriction components 24a and 24b from an example of drawing 1 . From a part of outside surface of a fixed part 22, the substantial drive parts 18 (part to which the electrodes 28 and 30 of a pair lap on both sides of piezo-electricity / electrostriction layer 26 in between) of these piezo-electricity / electrostriction components 24a and 24b are missing from a part of outside surface of the sheet metal sections 16a and 16b, and are formed continuously. Especially, in this example, each apical surface of the electrodes 28 and 30 of a pair is located in back end approach more slightly than wall 20a of moving part 20. Of course, you may make it form piezo-electricity / electrostriction components 24a and 24b so that said substantial drive part 18 may be applied and located in a part of sheet metal sections 16a and 16b from some moving part 20.

[0053] And in the piezo-electricity / electrostriction device 10A concerning the gestalt of the 1st operation of a ****, as shown in drawing 1 , the end faces 36a and 36b which counter moving part 20 mutually are formed and constituted. Each end faces 36a and 36b are fields almost parallel to the side face, i.e., the component forming face, of moving part 20, and they are mutually separated from the top face of moving part 20, applying them to a pore 12. It is desirable to make almost equal distance Da and Db from the medial axis n of moving part 20 to each end faces 36a and 36b so that it may be shown at this time, for example, drawing 12 .

[0054] Moreover, you may make it make an opening (air) 38 intervene, and may make it make the member 40 which consists of the piezo-electricity / electrostriction device 10Ag concerning the 7th modification shown in drawing 9 , a member which is different from the configuration member of said moving part 20 among these end faces 36a and 36b as shown in drawing 12 , for example, resin etc., etc. intervene among these end faces 36a and 36b, as shown in drawing 1 .

[0055] By the way, in the piezo-electricity / electrostriction device 10A concerning the gestalt of the 1st operation, impression of the electrical potential difference to the electrodes 28 and 30 of a pair is performed through the terminals (pad) 32 and 34 formed on the both-sides side (component forming face) of a fixed part 22 among each electrodes 28 and 30, respectively. The terminal 32 corresponding to one electrode 28 in the location of each terminals 32 and 34 is formed in the back end approach of a fixed part 22, and the terminal 34 corresponding to the electrode 30 of another side by the side of outer space is formed in the wall 22a approach of a fixed part 22.

[0056] In this case, immobilization of piezo-electricity / electrostriction device 10A can be separately performed using a field other than the field where terminals 32 and 34 have been arranged, respectively, and high dependability can be acquired as a result to the both sides of immobilization of piezo-electricity / electrostriction device 10A, and the electrical installation between a circuit, a terminal 32, and 34. In this configuration, electrical installation of terminals 32 and 34 and a circuit is performed by a flexible printed circuit (called FPC), a flexible flat cable (called FFC), wirebonding, etc.

[0057] As a configuration of piezo-electricity / electrostriction components 24a and 24b Like the piezo-electricity / electrostriction device 10Aa concerning the 1st modification shown in drawing 2 besides the configuration shown in drawing 1 Each point of the electrodes 28 and 30 of the pair which constitutes piezo-electricity / electrostriction components 24a and 24b is arranged. Like the piezo-electricity / electrostriction device 10Ab concerning the 2nd modification which you may make it make only the point of piezo-electricity / electrostriction layer 26 project to a moving-part 20 side, and is shown in drawing 3 Each point of one electrode 28, and the piezo-electricity / electrostriction layer 26 is arranged, and you may make it locate only the point of the electrode 30 of another side in fixed part 22 approach. In the piezo-electricity / electrostriction device 10Ab shown in this drawing 3 , the example which formed the end faces 36a and 36b which counter a fixed part 22 mutually instead of moving part 20 is shown.

[0058] in addition, the piezo-electricity / electrostriction device 10Ac concerning the 3rd modification shown in drawing 4 -- like -- each point of one electrode 28, and the piezo-electricity / electrostriction layer 26 -- the side face of moving part 20 -- extending -- the point of the electrode 30 of another side -- the die-length direction (Z shaft orientations) of the sheet metal sections 16a and 16b -- you may make it make it mostly located in the center

[0059] Although the electrodes 28 and 30 of the piezo-electricity / electrostriction layer 26 of 1 layer structure, and a

pair constituted piezo-electricity / electrostriction components 24a and 24b from the above-mentioned example, it is also desirable to carry out the plurality of the electrodes 28 and 30 of piezo-electricity / electrostriction layer 26, and a pair at a laminating gestalt, and to constitute piezo-electricity / electrostriction components 24a and 24b.

[0060] for example, like the piezo-electricity / electrostriction device 10Ad concerning the 4th modification shown in drawing 5 Make the electrodes 28 and 30 of a pair into multilayer structure at piezo-electricity / electrostriction layer 26 list, respectively, and the laminating of one electrode 28 and the electrode 30 of another side is carried out by turns, respectively. It is good also as the piezo-electricity / electrostriction components 24a and 24b by which the part (substantial drive part 18) to which one [these] electrode 28 and the electrode 30 of another side lap on both sides of piezo-electricity / electrostriction layer 26 in between was considered as the multistage configuration. In this drawing 5 , make piezo-electricity / electrostriction layer 26 into a three-tiered structure, and separate into the inferior surface of tongue (side face of the sheet metal sections 16a and 16b) of the 1st layer, and the top face of a two-layer eye, respectively, and one electrode 28 is formed in them. It separates into the top face of the 1st layer, and the top face of the 3rd layer, respectively, the electrode 30 of another side is formed in them, and the example which formed Terminals 32a and 32b in each edge of one electrode 28, respectively, and formed Terminals 34a and 34b in each edge of the electrode 30 of another side, respectively is shown further.

[0061] moreover, like the piezo-electricity / electrostriction device 10Ae concerning the 5th modification shown in drawing 6 The electrodes 28 and 30 of a pair are made into multilayer structure at piezo-electricity / electrostriction layer 26 list, respectively. The laminating of one electrode 28 and the electrode 30 of another side is alternately carried out, respectively so that it may become cross-section **** ctenidium-like. It is good also as the piezo-electricity / electrostriction components 24a and 24b by which the part (substantial drive part 18) to which one [these] electrode 28 and the electrode 30 of another side lap on both sides of piezo-electricity / electrostriction layer 26 in between was considered as the multistage configuration. This drawing 6 shows the example which made piezo-electricity / electrostriction layer 26 the three-tiered structure, formed in the shape of a ctenidium so that one electrode 28 might be located in the inferior surface of tongue (side face of the sheet metal sections 16a and 16b) of the 1st layer, and the top face of a two-layer eye, and was formed in the shape of a ctenidium so that the electrode 30 of another side might be located in the top face of the 1st layer, and the top face of the 3rd layer. Since the number of terminals 32 and 34 can be reduced compared with the configuration of drawing 5 by carrying out the bond communalization of the electrode 30 comrades of another side, respectively in one electrode 28 list in this configuration, enlargement of the size accompanying multilayering of piezo-electricity / electrostriction components 24a and 24b can be suppressed.

[0062] Moreover, you may make it form piezo-electricity / electrostriction components 24a and 24b in other examples of the piezo-electricity / electrostriction device 10Ae concerning said 5th modification so that the point may remain on sheet metal section 16a and 16b as shown in drawing 7 . the example of drawing 7 -- the point of piezo-electricity / electrostriction components 24a and 24b -- method ** of die length of the sheet metal section -- the example mostly located in the center section is shown. In this case, there is an advantage that the variation rate of the moving part 20 can be carried out greatly.

[0063] moreover, like the piezo-electricity / electrostriction device 10Af concerning the 6th modification shown in drawing 8 The piezo-electricity / electrostriction component 24a1 of two multistage configurations, and 24b1 are formed so that a fixed part 22 and the sheet metal sections 16a and 16b may be straddled, respectively. You may make it form the piezo-electricity / electrostriction component 24a2 of other two multistage configurations, and 24b2 so that moving part 20 and the sheet metal sections 16a and 16b may be straddled, respectively. In this case, it becomes what could be made to carry out the variation rate of the moving part 20 very greatly, and was excellent also in high-speed responsibility with the effectiveness which makes a multilevel structure piezo-electricity / electrostriction components 24a and 24b, and the effectiveness that the point of application for carrying out the variation rate of the moving part 20 increases in number, and is desirable.

[0064] moreover, like the piezo-electricity / electrostriction device 10Ag concerning the 7th modification shown in drawing 9 Make piezo-electricity / electrostriction layer 26 into two-layer structure, and it is formed in the shape of a ctenidium so that one electrode 28 may be located in the inferior surface of tongue (side face of the sheet metal sections 16a and 16b) of the 1st layer, and the top face of a two-layer eye. It is good also as the piezo-electricity / electrostriction components 24a and 24b of the multistage configuration formed so that the electrode 30 of another side might be located in the top face of the 1st layer. A member which is different in moving part 20 is filled up with this example between end-face 36a of moving part 20, and 36b.

[0065] While the generating force of piezo-electricity / electrostriction components 24a and 24b increases and has and about is planned very much by making such piezo-electricity / electrostriction components 24a and 24b into a multilevel structure, high resonance frequency-ization is attained and improvement in the speed of displacement actuation can

attain easily because the rigidity of the piezo-electricity / the electrostriction device 10A itself increases.
[0066] In addition, what is necessary is just to decide a number of stages etc. suitably according to an application and a busy condition, in actually carrying out in order for power consumption to also increase in connection with it although increase of driving force is achieved if a number of stages is made [many]. Moreover, fundamentally, even if it makes piezo-electricity / electrostriction components 24a and 24b into a multilevel structure and raises driving force in the piezo-electricity / electrostriction device 10A concerning the gestalt of this 1st operation, the width of face (distance of Y shaft orientations) of the sheet metal sections 16a and 16b serves as a very desirable device, since it is eternal, for example, when applying to actuators, such as positioning of the magnetic head for hard disks used in a very narrow gap, and ringing control. Moreover, since electrostatic capacity increases and a generating charge increases by considering as a multilevel structure when using it as a sensor (for example, acceleration sensor), there is an advantage that the level of the electrical signal which a sensor generates becomes large, and processing by the digital disposal circuit connected to the latter part of a sensor becomes easy.
[0067] Although the case where it constituted from so-called sandwich structure which made piezo-electricity / electrostriction layer 26 intervene between the electrode 28 of a pair and 30 in above-mentioned piezo-electricity / electrostriction components 24a and 24b was shown In addition, as are shown in drawing 10 , and you may make it form the electrodes 28 and 30 of the pair of a tandem type in one principal plane of the piezo-electricity / electrostriction layer 26 formed in the side face of the sheet metal sections 16a and 16b at least and it is shown in drawing 11 The electrodes 28 and 30 of the pair of a tandem type are embedded in the piezo-electricity / electrostriction layer 26 formed in the side face of the sheet metal sections 16a and 16b at least, and you may make it form.
[0068] In the case of the structure shown in drawing 10 , there is an advantage that power consumption can be stopped low and, in the case of the structure shown in drawing 11 , it becomes very advantageous to generating of an about from it being the structure where the inverse piezoelectric effect of the big direction of electric field of distortion and the generating force can be used effectively.
[0069] Specifically, the piezo-electricity / electrostriction components 24a and 24b which are shown in drawing 10 have the structure where come to form the electrodes 28 and 30 of the pair of tandem-type structure in one principal plane of piezo-electricity / electrostriction layer 26, and one electrode 28 and the electrode 30 of another side counter mutually with the gap 29 of fixed width of face alternately. Although drawing 10 showed the example which formed the electrodes 28 and 30 of a pair in one principal plane of piezo-electricity / electrostriction layer 26 In addition, may make it form the electrodes 28 and 30 of a pair between the sheet metal sections 16a and 16b, and the piezo-electricity / electrostriction layer 26, and You may make it form the electrodes 28 and 30 of the pair of a tandem type in the 1 principal-plane list of piezo-electricity / electrostriction layer 26, respectively between the sheet metal sections 16a and 16b, and the piezo-electricity / electrostriction layer 26.
[0070] On the other hand, the electrodes 28 and 30 of the pair of tandem-type structure are formed, and the piezo-electricity / electrostriction components 24a and 24b which are shown in drawing 11 have the structure where one electrode 28 and the electrode 30 of another side counter mutually with the gap 29 of fixed width of face alternately so that it may be embedded in piezo-electricity / electrostriction layer 26.
[0071] It can use suitable for the piezo-electricity / electrostriction device 10A which the piezo-electricity / electrostriction components 24a and 24b which are shown in such drawing 10 and drawing 11 also require for the gestalt of the 1st operation. Like the piezo-electricity / electrostriction components 24a and 24b which are shown in drawing 10 and drawing 11 , when using the electrodes 28 and 30 of the pair of a tandem type, it is making small the pitch D of the ctenidium of each electrodes 28 and 30, and it is possible to enlarge the variation rate of piezo-electricity / electrostriction components 24a and 24b.
[0072] Actuation of the piezo-electricity / electrostriction device 10A which starts the gestalt of this 1st operation here is explained. first, two piezo-electricity / electrostriction components 24a and 24b -- the natural condition 24a and 24b, i.e., piezo-electricity / electrostriction components, -- both -- a variation rate -- when not operating, it is shown in drawing 12 -- as -- the major axis (major axis of a fixed part 22) m of piezo-electricity / electrostriction device 10A, and the medial axis n of moving part 20 -- about -- I am doing one.
[0073] From this condition, as shown, for example in the wave form chart of drawing 13 A, the sine wave Wa which has the predetermined bias potential Vb is applied to the electrodes 28 and 30 of the pair in one piezo-electricity / electrostriction component 24a, and as shown in drawing 13 B, the sine wave Wb from which about about 180 degrees of phases differ is applied to the electrodes 28 and 30 of the pair in the piezo-electricity / electrostriction component 24b of another side in said sine wave Wa.
[0074] And in the phase where the electrical potential difference of maximum was impressed as opposed to the electrodes 28 and 30 of the pair in one piezo-electricity / electrostriction component 24a, the piezo-electricity /

electrostriction layer 26 in one piezo-electricity / electrostriction component 24a carry out contraction displacement in the direction of a principal plane. By this, as shown in drawing 14 , as an arrow head A shows, to one sheet metal section 16a Since the stress of the direction which sags this sheet metal section 16a rightward occurs, one [this] sheet metal section 16a bends rightward. At this time In the electrodes 28 and 30 of the pair in the piezo-electricity / electrostriction component 24b of another side, since an electrical potential difference will be in the condition of not being impressed, sheet metal section 16b of another side follows bending of one sheet metal section 16a, and bends rightward. Consequently, moving part 20 displaces rightward as opposed to the major axis m of piezo-electricity / electrostriction device 10A. In addition, the amount of displacement also becomes large, so that the amount of displacement changes according to the maximum of the electrical potential difference impressed to each piezo-electricity / electrostriction components 24a and 24b, for example, maximum becomes large.

[0075] When the piezo-electricity / electrostriction ingredient which has a high coercive electric field as a component of piezo-electricity / electrostriction layer 26 especially are applied, you may make it adjust said bias potential so that the level of the minimum value may turn into negative level slightly as shown in the wave of the two-dot chain line of drawing 13 A and drawing 13 B. In this case, the stress of the same direction occurs with the bending direction of one sheet metal section 16a in sheet metal section 16b of another side, and the drive of the piezo-electricity / electrostriction component (for example, piezo-electricity / electrostriction component 24b of another side) to which this negative level is impressed enables it to enlarge the amount of displacement of moving part 20 more. That is, the piezo-electricity / electrostriction component 24b, or 24a to which negative level is impressed can give the function to support the piezo-electricity / electrostriction component 24a, or 24b which is the subject of displacement actuation, by using a wave as shown with the alternate long and short dash line in drawing 13 A and drawing 13 B.

[0076] In addition, in the example of piezo-electricity / electrostriction device 10Af shown in drawing 8 , the electrical potential difference (refer to sine wave Wa) which has been arranged on the diagonal line and which is shown in drawing 13 A is impressed, for example to piezo-electricity / electrostriction component 24a1, and the piezo-electricity / electrostriction component 24b2, and the electrical potential difference (refer to sine wave Wb) shown in drawing 13 B is impressed to other piezo-electricity / electrostriction components 24a2, and the piezo-electricity / electrostriction component 24b1.

[0077] Thus, in the piezo-electricity / electrostriction device 10A concerning the gestalt of the 1st operation, in order for a variation rate with minute piezo-electricity / electrostriction components 24a and 24b to be amplified by big displacement actuation using bending of the sheet metal sections 16a and 16b and to transmit to moving part 20, moving part 20 becomes possible [carrying out a variation rate greatly to the major axis m of piezo-electricity / electrostriction device 10A].

[0078] He is trying to prepare moving part 20 especially the end faces 36a and 36b which counter mutually with the gestalt of this 1st operation. In this case, it becomes possible to raise resonance frequency, without being able to make into an opening 38 between the end faces 36a and 36b which counter mutually, or being able to attain lightweight-ization of moving part 20 effectively by making the member 40 lighter than the configuration member of moving part 20 intervene among said end faces 36a and 36b which counter mutually, and reducing the amount of displacement of moving part 20.

[0079] Here, a frequency switches in alternation the electrical potential difference impressed to the electrodes 28 and 30 of a pair, and shows the frequency of the voltage waveform when carrying out the variation rate of the moving part 20 to right and left, and when resonance frequency impresses a predetermined sinusoidal voltage, it shows the frequency from which the displacement amplitude of moving part 20 serves as max.

[0080] Moreover, it sets to the piezo-electricity / electrostriction device 10A concerning the gestalt of the 1st operation. The sheet metal sections 16a and 16b of a pair are metal, and other moving part 20 and fixed parts 22 have hybrid construction made into the product made from a ceramic. Since the piezo-electricity / electrostriction ingredient which is a brittle and comparatively heavy ingredient do not need to constitute all parts, A mechanical strength is high, is excellent in handling nature, shock resistance, and moisture resistance, and has on actuation the advantage of being hard to be influenced of a harmful vibration (for example, residual vibration and noise vibration at the time of a fast operation).

[0081] furthermore, some moving part 20 which contains one end-face 36a when between the end faces 36a and 36b which counter mutually is made into an opening 38 in the gestalt of this 1st operation -- some of 20A and another moving part 20 containing other-end side 36b -- 20B -- bending -- being easy -- it becomes strong to deformation. Therefore, it will excel in the handling nature of piezo-electricity / electrostriction device 10A.

[0082] Moreover, the surface area of moving part 20 or a fixed part 22 becomes large by existence of said end faces 36a and 36b which counter mutually. Therefore, as shown in drawing 1 , when it considers as the moving part 20 which has

the end faces 36a and 36b which counter mutually and attaches other components in moving part 20, the large clamp-face product can be taken and the attachment nature of components can be raised. Here, considering the case where components are fixed with adhesives etc., since adhesives will spread even round the end faces 36a and 36b besides one principal plane (components clamp face) of moving part 20, they become possible [canceling the lack of spreading of adhesives etc.], and can fix components certainly.

[0083] As this example, the case where the piezo-electricity / electrostriction device concerning the gestalt of this another operation (the piezo-electricity / electrostriction device ten A2 of another side) are fixed is shown to the moving part 20 of the piezo-electricity / electrostriction device (one piezo-electricity / electrostriction device ten A1) applied to the gestalt of this operation at drawing 15 .

[0084] The fixed part 22 has fixed one piezo-electricity / electrostriction device ten A1 on the front face of a substrate 122 through adhesives 120. In the moving part 20 of piezo-electricity / electrostriction device ten A1 of one of these, the fixed part 22 of the piezo-electricity / electrostriction device ten A2 of another side has fixed through adhesives 124. That is, it has the composition that two piezo-electricity / electrostriction devices ten A1, and ten A2 have been arranged at the serial. In addition, between end-face 36a in the piezo-electricity / electrostriction device ten A2 of another side which moving part 20 counters mutually, and 36b, a lightweight member 126 which is different in moving part 20 intervenes.

[0085] In this case, the adhesives 124 for fixing the piezo-electricity / electrostriction device ten A2 of another side have spread even among the end faces 36a and 36b of moving part 20 in one piezo-electricity / electrostriction device ten A1, and the piezo-electricity / electrostriction device ten A2 of another side will fix firmly by this to one piezo-electricity / electrostriction device ten A1. Moreover, if piezo-electricity / electrostriction device ten A2 is pasted up in this way, since a lightweight member (this example adhesives 124) which is different in moving part 20 between end-face 36a and 36b can be made placed between adhesion and coincidence, there is an advantage that a production process can be simplified.

[0086] It becomes possible to, fix firmly the piezo-electricity / electrostriction device 10Ab concerning this 2nd modification to a predetermined fixed portion on the other hand, in addition to the effectiveness in the case of having the end faces 36a and 36b which counter mutually in the moving part 20 which mentioned above, when it considers as the fixed part 22 which has the end faces 36a and 36b which counter mutually, as shown in drawing 3 , and improvement in dependability can be aimed at.

[0087] Moreover, he is trying to form continuously from a part of fixed part 22 in the gestalt of this 1st operation, applying [to which the electrodes 28 and 30 of a pair lap on both sides of piezo-electricity / electrostriction layer 26 in between] it to a part of sheet metal sections 16a and 16b (substantial drive part 18). Although there is a possibility that displacement actuation of moving part 20 may be restricted by said substantial drive part 18, and it may become impossible to obtain a big variation rate when it forms in some moving part 20 further, having applied the substantial drive part 18 With the gestalt of this 1st operation, since it forms so that said substantial drive part 18 may not be applied to moving part 20, un-arranging [that displacement actuation of moving part 20 is restricted] is avoided, and the amount of displacement of moving part 20 can be enlarged.

[0088] On the contrary, when forming piezo-electricity / electrostriction components 24a and 24b in some moving part 20, it is desirable to form so that said substantial drive part 18 may make it applied and located in a part of sheet metal sections 16a and 16b from some moving part 20. This is because displacement actuation of moving part 20 will be restricted as mentioned above if the substantial drive part 18 is formed over a part of fixed part 22.

[0089] Next, the desirable example of a configuration of the piezo-electricity / electrostriction device 10A concerning the gestalt of the 1st operation is explained.

[0090] First, in order to make displacement actuation of moving part 20 into a positive thing, it is desirable to make or more [of thickness d of the sheet metal sections 16a and 16b] into 1/2 distance g which requires the substantial drive parts 18 of piezo-electricity / electrostriction components 24a and 24b for a fixed part 22 or moving part 20.

[0091] and the ratio of the distance a between the walls of the sheet metal sections 16a and 16b (distance of X shaft orientations), and the width of face (distance of Y shaft orientations) b of the sheet metal sections 16a and 16b -- it constitutes so that a/b may be set to 0.5-20. Aforementioned ratio a/b is preferably set to 1-15, and is set to 1-10 still more preferably. this ratio -- the default value of a/b -- the variation rate of moving part 20 -- it is the convention based on discovery of an amount being enlarged and being able to obtain the variation rate in an X-Z flat surface dominantly.

[0092] on the other hand -- a ratio with the distance a between die-length (distance of Z shaft orientations) e of the sheet metal sections 16a and 16b, and the wall of the sheet metal sections 16a and 16b -- in e/a, it is desirable for it to be preferably referred to as 0.5-10, and to be referred to as 0.5-5 still more preferably.

[0093] Furthermore, it is desirable to fill up a pore 12, gel ingredient, for example, silicon gel. Usually, although

displacement actuation of moving part 20 will receive a limit by existence of a filler Since he is trying to attain lightweight-izing and increase-izing of the amount of displacement of moving part 20 accompanying the formation of end faces 36a and 36b to moving part 20 with the gestalt of this 1st operation, A limit of displacement actuation of the moving part 20 by said filler is negated, and the effectiveness by existence of a filler, i.e., a raise in resonance frequency, and rigid reservation can be realized.

[0094] Moreover, the short thing of die-length (distance of Z shaft orientations) f of moving part 20 is desirable. It is because increase of lightweight-izing and resonance frequency is achieved by shortening. however -- in order to secure the rigidity of X shaft orientations of moving part 20 and to make the variation rate into a positive thing -- a ratio with thickness d of the sheet metal sections 16a and 16b -- it is desirable to make f/d or more into five preferably two or more.

[0095] In addition, the actual size of each part will be set to the reinforcement of the whole plane-of-composition product [for installation], and piezo-electricity / electrostriction devices, such as plane-of-composition product [for attaching the plane-of-composition product for installation of the components to moving part 20, and a fixed part 22 in other members], and terminal for electrodes, 10A, durability, and the required amount list of displacement in consideration of resonance frequency, driver voltage, etc.

[0096] 100 micrometers - 2000 micrometers are desirable still more desirable, and, specifically, the distance a between the walls of the sheet metal sections 16a and 16b is 200 micrometers - 1600 micrometers. 50 micrometers - 2000 micrometers are desirable still more desirable, and the width of face b of the sheet metal sections 16a and 16b is 100 micrometers - 500 micrometers. thickness d of the sheet metal sections 16a and 16b -- the variation rate to Y shaft orientations -- the influence which is a component -- in relation with the width of face b of the sheet metal sections 16a and 16b, it considers as b>d and 2 micrometers - 100 micrometers are 10 micrometers - 80 micrometers desirable still more preferably so that a variation rate can control effectively.

[0097] 200 micrometers - 3000 micrometers are desirable still more desirable, and die-length e of the sheet metal sections 16a and 16b is 300 micrometers - 2000 micrometers. 50 micrometers - 2000 micrometers are desirable still more desirable, and die-length f of moving part 20 is 100 micrometers - 1000 micrometers.

[0098] Although the variation rate of Y shaft orientations does not exceed 10% to the variation rate of X shaft orientations by making it such a configuration, the extremely excellent effectiveness that a low-battery drive is possible by adjusting suitably in an above-mentioned dimension ratio and the range of an actual size, and the displacement component to Y shaft orientations can be controlled to 5% or less is shown. That is, moving part 20 will displace to 1 shaft orientations of X shaft orientations substantially, moreover, is excellent in high-speed responsibility, and can get a big variation rate by the low battery relatively.

[0099] Moreover, it sets to this piezo-electricity / electrostriction device 10A. tabular [the tabular configuration of a device is / like before] (variation rate configuration where the thickness of the direction which intersects perpendicularly with a direction is small) -- not but Moving part 20 and a fixed part 22 are presenting the configuration of a rectangular parallelepiped in general, and since the sheet metal sections 16a and 16b of a pair are formed so that the side face of moving part 20 and a fixed part 22 may continue, rigidity of Y shaft orientations of piezo-electricity / electrostriction device 10A can be alternatively made high.

[0100] That is, in this piezo-electricity / electrostriction device 10A, only actuation of the moving part 20 within a flat surface (inside of XZ flat surface) can be generated alternatively, and the actuation within YZ side of moving part 20 (the so-called actuation of the influence direction) can be controlled.

[0101] Next, each component of the piezo-electricity / electrostriction device 10A concerning the gestalt of this 1st operation is explained.

[0102] As moving part 20 mentioned above, it is the part which operates based on the amount of drives of the sheet metal sections 16a and 16b, and various members are attached according to the purpose of using piezo-electricity / electrostriction device 10A. For example, if it is the case where piezo-electricity / electrostriction device 10A is used as a displacement component, the shield of an optical shutter etc. will be attached, and if it is especially used for positioning and the ringing inhibition mechanism of the magnetic head of a hard disk drive, the member which needs positioning of the suspension which has the slider which has the magnetic head and the magnetic head, and a slider will be attached.

[0103] A fixed part 22 is a part which supports moving part 20 in sheet metal section 16a and 16b list as mentioned above, for example, when using for positioning of the magnetic head of said hard disk drive, the whole piezo-electricity / electrostriction device 10A are fixed to a fixed plate or a suspension etc. which was attached in VCM (voice coil motor) and attached in the carriage arm and this carriage arm by carrying out support immobilization of the fixed part 22. Moreover, as shown in drawing 1 , the terminals 32 and 34 for driving piezo-electricity / electrostriction

components 24a and 24b and other members may be arranged at this fixed part 22.
[0104] Although it is not limited as an ingredient which constitutes moving part 20 and a fixed part 22 especially as long as it has rigidity, the ceramics which can apply the ceramic green sheet laminated layers method mentioned later can be used suitably. Although the ingredient which specifically used as the principal component such mixture besides being the ingredient which uses zirconias including fully stabilized zirconia and partially stabilized zirconia, an alumina, a magnesia, silicon nitride, alumimium nitride, and titanium oxide as a principal component is mentioned, the ingredient with which a mechanical strength and toughness use a zirconia, especially fully stabilized zirconia as a principal component in a high point, and the ingredient which uses partially stabilized zirconia as a principal component are desirable. Moreover, in a metallic material, although it is not limited as long as it has rigidity, stainless steel, nickel, brass, cupronickel, bronze, etc. are mentioned.
[0105] That by which partial stabilization was carried out as follows in partially stabilized zirconia in the stabilization list at said fully-stabilized-zirconia list is desirable. namely, as a compound which carries out partial stabilization, a zirconia in a stabilization list Although a zirconia will be stabilized partially or completely by there being an oxidization yttrium, an oxidization ytterbium, cerium oxide, a calcium oxide, and a magnesium oxide, and making one of compounds [them] add and contain at least The stabilization of a zirconia made into the purpose is possible also by adding the stabilization not only combining addition of one kind of compound but combining these compounds.
[0106] In addition, as an addition of each compound, if it is in the case of an oxidization yttrium or an oxidization ytterbium 1-30-mol % -- preferably, if it is in the case of 1.5-10-mol % and cerium oxide 6-50-mol % -- preferably, if it is in the case of 8-20-mol % and a calcium oxide, or a magnesium oxide Although it is desirable % and to 5-40-mol consider as 5-20-mol % preferably, also especially in it, it is desirable to use yttrium oxide as a stabilizing agent, and it is desirable % and to 1.5-10-mol consider as 2-4-mol % still more preferably in that case. Moreover, although it is possible to add an alumina, a silica, a transition-metals oxide, etc. in 0.05 - 20wt% as additives, such as sintering acid, when adopting the baking unification by the film forming method as the formation technique of piezo-electricity / electrostriction components 24a and 24b, it is also desirable to add an alumina, a magnesia, a transition-metals oxide, etc. as an additive.
[0107] In addition, it is desirable to set preferably 0.05-3 micrometers of average crystal particle diameter of a zirconia to 0.05-1 micrometer so that a mechanical strength and the stable crystal phase may be obtained. Moreover, although the same ceramics as a fixed part 22 can be used for moving-part 20 list about the sheet metal sections 16a and 16b as mentioned above, constituting preferably using the same ingredient substantially is advantageous when aiming at reduction of the dependability for a joint, the reinforcement of piezo-electricity / electrostriction device 10A, and the complicatedness of manufacture.
[0108] The sheet metal sections 16a and 16b are parts driven with the variation rate of piezo-electricity / electrostriction components 24a and 24b, as mentioned above. telescopic motion of the piezo-electricity / electrostriction components 24a and 24b which the sheet metal sections 16a and 16b are the members of the shape of sheet metal which has flexibility, and were arranged in the front face -- a variation rate -- crookedness -- it amplifies as a variation rate and has the function transmitted to moving part 20. Therefore, if the configuration and the quality of the material of the sheet metal sections 16a and 16b have flexibility and have the mechanical strength of extent which is not damaged by flexion deformity, it is sufficient for them, and they can be suitably chosen in consideration of the responsibility of moving part 20, and operability.
[0109] As for thickness d of the sheet metal sections 16a and 16b, it is desirable to be referred to as 2 micrometers - about 100 micrometers, and, as for the thickness which doubled the sheet metal sections 16a and 16b, and the piezo-electricity / electrostriction components 24a and 24b, it is desirable to be referred to as 7 micrometers - 500 micrometers. As for the thickness of 0.1-50 micrometers, and the piezo-electricity / electrostriction layer 26, it is [the thickness of electrodes 28 and 30] desirable to be referred to as 3-300 micrometers. Moreover, as width of face b of the sheet metal sections 16a and 16b, 50 micrometers - 2000 micrometers are suitable.
[0110] On the other hand, if the configuration and the quality of the material of the sheet metal sections 16a and 16b have flexibility and have the mechanical strength of extent which is not damaged by flexion deformity, it is sufficient for them, and a metal is adopted preferably. In this case, as above-mentioned, to have flexibility and what is necessary is just the metallic material of 100 or more GPas of Young's modulus at the metallic material and concrete target which can be deformed by flexion.
[0111] Preferably, as an iron system ingredient, it is desirable to constitute from stainless steel of the martensitic stainless steel of the ferritic stainless steel of the austenitic stainless steel of SUS301, SUS304, AISI653, and SUH660 grade, SUS430, and 434 grades, SUS410, and SUS630 grade, SUS631, and AISI632 grade, such as semi austenite, maraging stainless steel, and various spring steel steel materials. Moreover, as a non-iron system ingredient, it is

desirable to constitute from superelastic titanium alloys including a titanium-nickel alloy, brass, cupronickel, aluminum, a tungsten, molybdenum, beryllium copper, phosphor bronze, nickel, a ferronickel alloy, titanium, etc.

[0112] As the sheet metal sections 16a and 16b, like moving part 20 or a fixed part 22, when using the ceramics, a zirconia is suitable. Even if the ingredient which uses fully stabilized zirconia as a principal component especially, and the ingredient which uses partially stabilized zirconia as a principal component are thin meat, it is most suitably used from that a mechanical strength is large, that toughness is high, and reactivity with piezo-electricity / electrostriction layer 26, or electrode material being small.

[0113] Although piezo-electricity / electrostriction components 24a and 24b have the electrodes 28 and 30 of the pair for applying electric field to piezo-electricity / electrostriction layer 26, and this the piezo-electricity / electrostriction layer 26 at least and piezo-electricity / electrostriction components, such as a uni-morph mold and a bimorph mold, can be used for them It excels in the stability of the amount of displacement to generate, and since it is advantageous to lightweight-izing, the direction of the uni-morph mold combined with the sheet metal sections 16a and 16b is suitable for such piezo-electricity / electrostriction device 10A.

[0114] For example, as shown in drawing 1 , the piezo-electricity / electrostriction component by which the laminating of one electrode 28, the piezo-electricity / electrostriction layer 26, and the electrode 30 of another side was carried out to the shape of a layer can be used suitably, and also as shown in drawing 5 - drawing 9 , you may make it a multistage configuration. In this case, the location gap of the film (electrode layer) which constitutes electrodes 28 and 30, i.e., a location gap of the direction of a field in the perpendicular plane of projection in every other [28], for example, an electrode, layer, is 50 micrometers or less. As for this, the same is said of an electrode 30.

[0115] As said piezo-electricity / electrostriction components 24a and 24b are shown in drawing 1 , although it is desirable, in that the direction formed in the external surface side of piezo-electricity / electrostriction device 10A can make the sheet metal sections 16a and 16b drive more greatly According to a use gestalt etc., you may form in the inside side of piezo-electricity / electrostriction device 10A, i.e., the internal surface of a pore 12, and may form in the both sides by the side of the external surface of piezo-electricity / electrostriction device 10A, and an inside.

[0116] Although electrostrictive ceramics is suitably used for piezo-electricity / electrostriction layer 26, it is also possible to use the electrostriction ceramics, the ferroelectric ceramics, or the antiferroelectric crystal ceramics. However, since linearity with the amount of displacement of moving part 20, driver voltage, or output voltage is made important when using this piezo-electricity / electrostriction device 10A for positioning of the magnetic head of a hard disk drive etc., it is desirable to use the small ingredient of distortion hysteresis, and it is desirable that a coercive electric field uses an ingredient 10kV [/mm] or less.

[0117] The ceramics which is independent or contains lead zirconate, lead titanate, magnesium niobic acid lead, nickel niobic acid lead, zinc niobic acid lead, manganese niobic acid lead, antimony stannic-acid lead, a manganese lead wolframate, cobalt niobic acid lead, barium titanate, a titanic-acid sodium bismuth, niobic acid potassium sodium, a tantalic acid strontium bismuth, etc. as mixture as a concrete ingredient is mentioned.

[0118] When it has a high electromechanical coupling coefficient and a high piezoelectric constant, the sheet metal sections 16a and 16b are used as the ceramics and it really calcinates piezo-electricity / electrostriction layer 26 especially, reactivity with the sheet metal sections 16a and 16b (ceramics) is small, and the ingredient which uses lead zirconate, lead titanate, and magnesium niobic acid lead as a principal component, or the ingredient which uses a titanic acid sodium bismuth as a principal component is suitably used in the point that the thing of the stable presentation is obtained.

[0119] Furthermore, the ceramics which be independent or mixed the compound which contain in said ingredient oxides, such as a lanthanum, calcium, strontium, molybdenum, a tungsten, barium, niobium, zinc, nickel, manganese, a cerium, cadmium, chromium, cobalt, antimony, iron, an yttrium, a tantalum, a lithium, a bismuth, and tin, or at least one component which finally serve as an oxide may be use.

[0120] For example, an advantage, like adjustment of a coercive electric field and a piezo-electric property is attained can be acquired by making the lead zirconate, lead titanate, and magnesium niobic acid lead which are a principal component contain a lanthanum and strontium.

[0121] In addition, as for addition of ingredients which are easy to vitrify, such as a silica, avoiding is desirable. It is because ingredients, such as a silica, tend to react with piezo-electricity / electrostriction ingredient at the time of heat treatment of piezo-electricity / electrostriction layer, the presentation is fluctuated and a piezo-electric property is degraded.

[0122] On the other hand, the electrodes 28 and 30 of the pair of piezo-electricity / electrostriction components 24a and 24b Are a solid-state at a room temperature and it is desirable to consist of metals excellent in conductivity. For example, aluminum, titanium, chromium, iron, cobalt, nickel, copper, Zinc, niobium, molybdenum, a ruthenium,

palladium, a rhodium, silver, Metal simple substances, such as tin, a tantalum, a tungsten, iridium, platinum, gold, and lead, or these alloys are used, and the cermet ingredient which made these distribute the ceramics of the same ingredient as piezo-electricity / electrostriction layer 26 or a different ingredient further may be used.

[0123] It opts for the material selection of the electrodes 28 and 30 in piezo-electricity / electrostriction components 24a and 24b depending on the formation approach of piezo-electricity / electrostriction layer 26. For example, when forming piezo-electricity / electrostriction layer 26 by baking on one [this] electrode 28 after forming one electrode 28 on sheet metal section 16a and 16b Although it is necessary to use refractory metals, such as platinum which does not change in the burning temperature of piezo-electricity / electrostriction layer 26, palladium, a platinum-palladium alloy, and a silver-palladium alloy, for one electrode 28 Since the electrode 30 of another side in the case of being located in the outermost layer formed on this piezo-electricity / electrostriction layer 26 after forming piezo-electricity / electrostriction layer 26 can perform electrode formation at low temperature, low melting point metals, such as aluminum, gold, and silver, can be used for it.

[0124] When said laminating mold piezo-electricity / electrostriction component 24 are stuck with adhesives 202 to the sheet metal sections 16a and 16b, after the laminating of piezo-electricity / electrostriction layer 26, and the electrodes 28 and 30 (electrode layer) is carried out to a multilayer and made one, being calcinated by package is desirable and the electrodes 28 and 30 in that case use refractory metals, such as platinum, palladium, and those alloys. Moreover, as for electrodes 28 and 30, it is desirable to consider as a refractory metal, piezo-electricity / electrostriction ingredient, or the cermet that is mixture with other ceramics.

[0125] Moreover, as for the thickness of electrodes 28 and 30, it is desirable to use ingredients, such as the organic metal paste with which the precise and thinner film is obtained after baking, for example, a golden resinate paste, a platinum resinate paste, and a silver resinate paste, for the electrode in which the factor which reduces the variation rate of piezo-electricity / electrostriction components 24a and 24b not a little is formed after baking of a sake, especially the piezo-electricity / electrostriction layer 26.

[0126] Next, some manufacture approaches of of the piezo-electricity / electrostriction device 10A concerning the gestalt of the 1st operation are explained, referring to drawing 16 A - drawing 23 .

[0127] The piezo-electricity / electrostriction device 10A concerning the gestalt of the 1st operation make metal the sheet metal sections 16a and 16b, and is using the component of moving part 20 and a fixed part 22 as the ceramics. Therefore, remove piezo-electricity / electrostriction components 24a and 24b in sheet metal section 16a and 16b list as a component of piezo-electricity / electrostriction device 10A. It is desirable to manufacture using a ceramic green sheet laminated layers method about a fixed part 22 and moving part 20, and it is desirable to manufacture on the other hand using the film formation technique, such as a thin film and a thick film, about each terminals 32 and 34 including piezo-electricity / electrostriction components 24a and 24b.

[0128] And fixing of moving part 20 and the sheet metal sections 16a and 16b to the side face of a fixed part 22 has desirable fixing by adhesives 200, and is [fixing of the piezo-electricity / electrostriction components 24a and 24b to sheet metal section 16a and 16b top] desirable. [of fixing by adhesives 202]

[0129] According to the ceramic green sheet laminated layers method which can fabricate the moving part 20 and the fixed part 22 of piezo-electricity / electrostriction device 10A in one, since the change of state of the joint of each part material with time hardly arises, the dependability like a joint is a high and approach advantageous to rigid reservation.

[0130] In the piezo-electricity / electrostriction device 10A concerning the gestalt of this 1st operation, since the boundary part of the sheet metal sections 16a and 16b and moving part 20 serves as the supporting point of a displacement manifestation at the boundary partial list of the sheet metal sections 16a and 16b and a fixed part 22, the dependability of these boundary part is the important point which influences the property of piezo-electricity / electrostriction device 10A.

[0131] since [moreover,] the manufacture approach shown below is excellent in productivity or a moldability -- the piezo-electricity / electrostriction device of a predetermined configuration -- a short time -- and it can obtain with sufficient repeatability.

[0132] Hereafter, the 1st manufacture approach of of the piezo-electricity / electrostriction device 10A which starts the gestalt of the 1st operation concretely is explained. Here, the definition is carried out. The layered product obtained by carrying out the laminating of the ceramic green sheet is defined as the ceramic Green layered product 158 (for example, refer to drawing 16 B). What calcinated this ceramic Green layered product 158, and was unified is defined as the ceramic layered product 160 (for example, refer to drawing 17 A). What stuck the ceramic layered product 160 and the metal plate is defined as the hybrid layered product 162 (refer to drawing 18). The thing which excises an unnecessary part from this hybrid layered product 162 and by which the fixed part 22 was united with moving part 20, sheet metal section 16a, and 16b list is defined as base 14D (refer to drawing 19).

[0133] Moreover, in this 1st manufacture approach, finally the hybrid layered product 162 is cut per chip, and although much piezo-electricity / electrostriction device 10A are taken and carried out, in order to simplify explanation, it explains by making one-piece picking of piezo-electricity / electrostriction device 10A into a subject.
[0134] First, addition mixing of a binder, a solvent, a dispersant, the plasticizer, etc. is carried out at ceramic powder, such as a zirconia, a slurry is produced, and the ceramic green sheet which has predetermined thickness for this by approaches, such as the reverse roll coater method and a doctor blade method, after degassing processing is produced.
[0135] Next, a ceramic green sheet is processed into various configurations like drawing 16 A by approaches using metal mold, such as blanking processing and laser beam machining. On the ceramic green sheet for base formation of two or more sheets, and a concrete target The ceramic green sheets 50A-50D of two or more sheets (for example, four sheets) with which the window part 54 which forms a pore 12 behind at least was formed, The window part 100 for forming the window part 54 which forms a pore 12 behind, and the moving part 20 which has the end faces 36a and 36b which counter mutually prepares the ceramic green sheet 102 by which continuation formation was carried out.
[0136] then, it is shown in drawing 16 B -- as -- ceramic green sheet 50A- the laminating and sticking by pressure of 50D and 102 are done, and it considers as the ceramic Green layered product 158. In this laminating, the ceramic green sheet 102 is located in the center, and carries out a laminating. Then, the ceramic Green layered product 158 is calcinated, and as shown in drawing 17 A, the ceramic layered product 160 is obtained. At this time, it becomes the form where the pore 130 by window parts 54 and 100 was formed at the ceramic layered product 160.
[0137] Next, as shown in drawing 17 B, the piezo-electricity / electrostriction components 24a and 24b which were constituted as another object are pasted up on the front face of the metal plates 152A and 152B which serve as the sheet metal section, respectively with the epoxy system adhesives 202.
[0138] Next, as a pore 130 is closed, these metal plates 152A and 152B are pasted up on the ceramic layered product 160 with the adhesives 200 of an epoxy system, and it considers as the hybrid layered product 162 (refer to drawing 18) so that the ceramic layered product 160 may be put with metal plates 152A and 152B.
[0139] Next, as shown in drawing 18 , the flank and point of the hybrid layered product 162 are excised by cutting along with cutting plane lines C1, C2, and C5 among the hybrid layered products 162 in which piezo-electricity / electrostriction components 24a and 24b were formed. By this excision, as shown in drawing 19 , the piezo-electricity / electrostriction device 10A concerning the gestalt of the 1st operation in which piezo-electricity / electrostriction components 24a and 24b were formed in the sheet metal sections 16a and 16b which consisted of metal plates among base 14D, and the moving part 20 which has the end faces 36a and 36b which counter mutually was formed are obtained.
[0140] The window part 100 for forming the moving part 20 which has the end faces 36a and 36b which counter as mutually on the other hand as the ceramic green sheets 50A-50D of two or more sheets (for example, four sheets) with which the window part 54 in which the 2nd manufacture approach forms a pore 12 behind at least as first shown in drawing 20 A was formed, and the window part 54 which forms a pore 12 in behind prepares the ceramic green sheet 102 by which continuation formation was carried out.
[0141] then, it is shown in drawing 20 B -- as -- ceramic green sheet 50A- the laminating and sticking by pressure of 50D and 102 are done, and it considers as the ceramic Green layered product 158. Then, the ceramic Green layered product 158 is calcinated, and as shown in drawing 21 A, the ceramic layered product 160 is obtained. At this time, it becomes the form where the pore 130 by window parts 54 and 100 was formed at the ceramic layered product 160.
[0142] Next, as shown in drawing 21 B, as a pore 130 is closed, these metal plates 152A and 152B are pasted up on the ceramic layered product 160 with the adhesives 200 of an epoxy system, and it considers as the hybrid layered product 162 so that the ceramic layered product 160 may be put with metal plates 152A and 152B. In case piezo-electricity / electrostriction components 24a and 24b are stuck on the front face of the pasted-up metal plates 152A and 152B at this time, as shown in drawing 21 A, a pore 130 is filled up with a filler 164 if needed, so that sufficient adhesion pressure may be put.
[0143] Since it is finally necessary to remove a filler 164, it is easy to dissolve in a solvent etc., and it is desirable that it is a hard ingredient, for example, organic resin, a wax, a low, etc. are mentioned. Moreover, the ingredient which mixed ceramic powder as a filler is also employable as organic resin, such as an acrylic.
[0144] Next, as shown in drawing 21 B, the piezo-electricity / electrostriction components 24a and 24b which were formed in the front face of the metal plates 152A and 152B in the hybrid layered product 162 as another object are pasted up with the adhesives 202 of an epoxy system. The piezo-electricity / electrostriction components 24a and 24b of another object can be formed with for example, a ceramic green sheet laminated layers method and a printing multilayer method.
[0145] Next, as shown in drawing 22 , the flank and point of the hybrid layered product 162 are excised by cutting along

with cutting plane lines C1, C2, and C5 among the hybrid layered products 162 in which piezo-electricity / electrostriction components 24a and 24b were formed. By this excision, as shown in drawing 23 , the piezo-electricity / electrostriction device 10A concerning the gestalt of the 1st operation in which piezo-electricity / electrostriction components 24a and 24b were formed in the sheet metal sections 16a and 16b which consisted of metal plates among base 14D, and the moving part 20 which has the end faces 36a and 36b which counter mutually was formed are obtained.

[0146] Moreover, what is necessary is to form the part equivalent to the ceramic layered product 160 in drawing 17 A by casting, in using all the base sections as a metal, and also to form a bulk-like member by the approach of a grinding process, a wire electron discharge method, metal mold blanking processing, and chemical etching, or to carry out the laminating of the sheet metal-like metal, and just to form by the cladding method.

[0147] Next, it explains, referring to drawing 24 - drawing 52 about the piezo-electricity / electrostriction device 10B concerning the gestalt of the 2nd operation.

[0148] As shown in drawing 24 , the piezo-electricity / electrostriction device 10B concerning the gestalt of this 2nd operation possess the sheet metal sections 16a and 16b of the pair which carries out phase opposite, and the fixed part 22 which supports these sheet metal sections 16a and 16b, and among the sheet metal sections 16a and 16b of said pair, laminating mold piezo-electricity / electrostriction component 24 is arranged by one sheet metal section 16a, and it is constituted. In addition, since laminating mold piezo-electricity / electrostriction component 24 has complicated structure, drawing 24 and drawing 25 are simplified and shown, and the detailed enlarged drawing has been shown in drawing 26 - drawing 29 .

[0149] Between each back end section of the sheet metal sections 16a and 16b of a pair, a fixed part 22 fixes with adhesives 200, and each point of the sheet metal sections 16a and 16b of a pair serves as an open end.

[0150] Between each point in the sheet metal sections 16a and 16b of a pair, as shown in drawing 25 , moving part 20, or an above-mentioned various member and above-mentioned various components fix through adhesives 200. The example of drawing 25 shows the example which fixed the moving part 20 which consisted of same members as a fixed part 22 between each point in the sheet metal sections 16a and 16b of a pair through adhesives 200.

[0151] The sheet metal sections 16a and 16b of a pair consist of metals, respectively, and are constituted by a fixed part 22 and moving part 20 using the ceramics or a metal. More nearly especially than the thickness of sheet metal section 16b of another side, in the example of drawing 24 or drawing 25 , laminating mold piezo-electricity / electrostriction component 24 is formed for while among the sheet metal sections 16a and 16b of a pair, and let thickness of sheet metal section 16a be size.

[0152] Moreover, laminating mold piezo-electricity / electrostriction component 24 is stuck to sheet metal section 16a with the adhesives 202, such as organic resin, glass, low attachment, soldering, and eutectic bonding. That is, when said laminating mold piezo-electricity / electrostriction component 24 fix through adhesives 202 to metal sheet metal section 16a, the actuator section 204 which is the driving source of piezo-electricity / electrostriction device 10B will be constituted.

[0153] And the point (part in which moving part 20 was attached) in sheet metal section 16a (the example of drawing 25 16a and 16b) displaces this piezo-electricity / electrostriction device 10B by the drive of the actuator section 204. Or the variation rate of the point in sheet metal section 16a will be electrically detected through the actuator section (it is the DORANSUDEYUSA section when using it as a sensor) 204. In this case, it will be used as a sensor.

[0154] As shown in drawing 26 , the electrodes 28 and 30 of a pair are made into multilayer structure at piezo-electricity / electrostriction layer 26 list, respectively, the laminating of one electrode 28 and the electrode 30 of another side is carried out by turns, respectively, and, as for laminating mold piezo-electricity / electrostriction component 24, the part to which one [these] electrode 28 and the electrode 30 of another side lap on both sides of piezo-electricity / electrostriction layer 26 in between is considered as the multistage configuration.

[0155] In drawing 26 , the electrodes 28 and 30 of a pair are made into multilayer structure at piezo-electricity / electrostriction layer 26 list, respectively, the laminating of one electrode 28 and the electrode 30 of another side is alternately carried out, respectively so that it may become cross-section **** ctenidium-like, and the part to which one [these] electrode 28 and the electrode 30 of another side lap on both sides of piezo-electricity / electrostriction layer 26 in between is considered as the multistage configuration.

[0156] In detail, said laminating mold piezo-electricity / electrostriction component 24 present a rectangular parallelepiped configuration mostly, and consists of two or more piezo-electricity / electrostriction layer 26, and electrode layers 28 and 30. And the electrode layers 28 and 30 which touch the vertical side of each piezo-electricity / electrostriction layer 26 are alternately drawn by the opposite end faces 208 and 209, respectively. The end-face electrodes 28c and 30c which connect electrically each electrode layers 28 and 30 drawn by the alternate opposite end

faces 208 and 209 concerned It is prepared in the front face of the piezo-electricity / electrostriction layer 26 of the outermost layer, and connects with the terminal areas 28b and 30b which only the predetermined distance Dk leaves and by which it has been arranged electrically.
[0157] As for the predetermined distance Dk between said terminal area 28b and 30b, it is desirable that it is 20 micrometers or more. Moreover, you may make it change the quality of the material of electrode layers 28 and 30 and the quality of the material of the end-face electrodes 28c and 30c which touch the vertical side of piezo-electricity / electrostriction layer 26. Moreover, you may make it connect electrically one [at least] terminal area (the example of drawing 26 terminal area 28b), this terminal area 28b, and corresponding end-face electrode 28c by 28d (outside-surface electrode) of electrode layers of a thin film thinner than these terminal area 28b and end-face electrode 28c.
[0158] Moreover, 28d of electrode layers of the front face formed after baking of piezo-electricity / electrostriction layer 26, the end-face electrodes 28c and 30c, and terminal areas 28b and 30b are good also as a heat-resistant low thing thinner than the electrode layers 28 and 30 which are formed before baking of piezo-electricity / electrostriction layer 26, or are calcinated by coincidence and.
[0159] This drawing 26 shows the example which made piezo-electricity / electrostriction layer 26 5 layer structures, formed one electrode 28 in the shape of a ctenidium so that it might be located in the top face of the 1st layer, the top face of the 3rd layer, and the top face of the 5th layer, and formed the electrode 30 of another side in the shape of a ctenidium so that it might be located in the top face of a two-layer eye, and the top face of the 4th layer.
[0160] Moreover, drawing 28 shows the example which similarly made piezo-electricity / electrostriction layer 26 5 layer structures, formed one electrode 28 in the shape of a ctenidium so that it might be located in the top face of the 1st layer, the top face of the 3rd layer, and the top face of the 5th layer, and formed the electrode 30 of another side in the shape of a ctenidium so that it might be located in the inferior surface of tongue of the 1st layer, the top face of a two-layer eye, and the top face of the 4th layer.
[0161] Since the increment in the number of terminals can be controlled in one electrode 28 list by carrying out the bond communalization of the electrode 30 comrades of another side, respectively in these configurations, enlargement of the size by having used laminating mold piezo-electricity / electrostriction component 24 can be suppressed.
[0162] Thus, while the driving force of the actuator section 204 increases and has and about is planned very much by using laminating mold piezo-electricity / electrostriction component 24, high resonance frequency-ization is attained and improvement in the speed of displacement actuation can attain easily because the rigidity of the piezo-electricity / the electrostriction device 10B itself increases.
[0163] In addition, what is necessary is just to decide a number of stages etc. suitably according to an application and a busy condition, in carrying out in order for power consumption to also increase in connection with it although increase of the driving force of the actuator section 204 is achieved if a number of stages is made [many]. moreover, in the piezo-electricity / electrostriction device 10B concerning the gestalt of this 2nd operation Even if it raises the driving force of the actuator section 204 by using laminating mold piezo-electricity / electrostriction component 24, fundamentally the width of face (distance of Y shaft orientations) b of the sheet metal sections 16a and 16b Since it is eternal, For example, when applying to actuators, such as positioning of the magnetic head for hard disks used in a very narrow gap, and ringing control, it becomes a very desirable device.
[0164] It is related with the formation location of the laminating mold piezo-electricity / electrostriction component 24 to sheet metal section 16a here. The location where the apical surface 208 of the multilayer object which constitutes said laminating mold piezo-electricity / electrostriction component 24 does not contain a fixed part 22 at least superficially (in the example of drawing 25) In the location included in the hole formed between moving part 20 and a fixed part 22 The back end side 209 of the multilayer object which constitutes said laminating mold piezo-electricity / electrostriction component 24 It is the location which contains a fixed part 22 at least superficially, and edge 28a of an electrode 28 is a location which contains a fixed part 22 at least superficially. As for edge 30a of an electrode 30, it is desirable to be formed in the location (location included in the hole similarly formed between moving part 20 and a fixed part 22 in the example of drawing 25) which does not contain a fixed part 22 superficially.
[0165] In addition, impression of the electrical potential difference to the electrodes 28 and 30 of a pair is performed through the edge (terminal areas 28b and 30b) of each electrodes 28 and 30 formed on layer [5th] piezo-electricity / the electrostriction layer 26. Each terminal areas 28b and 30b are estranged and formed in extent which can be insulated electrically.
[0166] The predetermined spacing Dk of terminal areas 28b and 30b has desirable 20 micrometers or more, and when the thickness of terminal areas 28b and 30b is 1 micrometer - 30 micrometers, its 50 micrometers or more are still more desirable. Moreover, even if terminal areas 28b and 30b are the quality of the materials which are different even if it is the same quality of the material as internal electrodes 28 and 30, they are not cared about. For example, what is

necessary is to consider as the same quality of the material, and just to consider as the different quality of the material in another baking, when carrying out coincidence baking with piezo-electricity / electrostriction layer 26.
[0167] As for the end-face electrodes 28c and 30c, it is desirable for grinding, polish, etc. to make after baking of piezo-electricity / electrostriction layer 26 and these end faces an internal electrode 28 and 30 lists, and to connect an internal electrode and an end-face electrode electrically. The quality of the material of the end-face electrodes 28c and 30c may be the same as internal electrodes 28 and 30, and you may differ. For example, to a platinum paste and 28d of outside-surface electrodes, although it is desirable to internal electrodes 28 and 30 to use a golden paste for terminal areas 28b and 30b, the almost same configuration as the piezo-electricity / electrostriction device 10A concerning the gestalt of the 1st operation mentioned above can also be taken in golden resinate and end-face electrode 28c and 30c list at them.
[0168] In this case, immobilization of piezo-electricity / electrostriction device 10B can be separately performed using a field other than the field where terminal areas 28b and 30b have been arranged, respectively, and high dependability can be acquired as a result to the both sides of immobilization of piezo-electricity / electrostriction device 10B, and the electrical installation between a circuit, terminal area 28b, and 30b. In this configuration, electrical installation of terminal areas 28b and 30b and a circuit is performed by a flexible printed circuit, a flexible flat cable, wirebonding, etc.

[0169] Thus, it sets to the piezo-electricity / electrostriction device 10B concerning the gestalt of the 2nd operation. Since laminating mold piezo-electricity / electrostriction component 24 is made to fix through adhesives 202 and he is trying to constitute the actuator section 204 on metal sheet metal section 16a, Even if it does not extend the area on the flat surface of laminating mold piezo-electricity / electrostriction component 24, the variation rate of the sheet metal section 16a (and 16b) can be carried out greatly, and moreover, since sheet metal section 16a (and 16b) is metal, it excels in reinforcement or toughness and can respond also to rapid displacement actuation.
[0170] That is, with the gestalt of this 2nd operation, it can fully respond also in fluctuation and the severe busy condition of an operating environment. While being able to excel in shock resistance, being able to aim at reinforcement of piezo-electricity / electrostriction device 10B, and improvement in handling nature and being able to carry out the variation rate of the sheet metal section 16a (and 16b) greatly by the low battery relatively moreover the rigidity of sheet metal section 16a (and 16b) -- high -- moreover, the thickness of the actuator section 204 -- thick -- since rigidity is high -- the variation rate of sheet metal section 16a (and 16b) -- improvement in the speed (raise in resonance frequency) of operation can be made to attain
[0171] Usually, in the actuator section 204 which combined sheet metal section 16a, and the laminating mold piezo-electricity / electrostriction component 24 which carries out distortion deformation, it is required to raise the rigidity of the actuator section 204 for driving this at a high speed, and it is required for obtaining a big variation rate to lower the rigidity of the actuator section 204.
[0172] However, it sets to the piezo-electricity / electrostriction device 10B concerning the gestalt of this 2nd operation. Make the sheet metal sections 16a and 16b which constitute the actuator section 204 counter, and it considers as the sheet metal sections 16a and 16b of a pair. Between each back end section of the sheet metal sections 16a and 16b of this pair, fix a fixed part 22 with adhesives 200, make laminating mold piezo-electricity / electrostriction component 24 into a multilevel structure, and the location of the laminating mold piezo-electricity / the electrostriction component 24 concerned and the quality of the material of a configuration member, and magnitude are chosen suitably. It becomes possible, since piezo-electricity / electrostriction device 10B was constituted to reconcile the above opposite properties. The minimum resonance frequency of the structure in case the body of comparable magnitude intervenes substantially with a fixed part 22 between the open ends of the sheet metal sections 16a and 16b of said pair is 20kHz or more. The amount of relative displacements of said body and fixed part 22 becomes possible [being referred to as 0.5 micrometers or more by ontic applied-voltage 30V on 1/4 or less frequency of said resonance frequency].
[0173] Consequently, while being able to carry out the variation rate of the sheet metal sections 16a and 16b of a pair greatly, improvement in the speed (raise in resonance frequency) of displacement actuation of piezo-electricity / electrostriction device 10B, especially the sheet metal sections 16a and 16b of a pair can be made to attain.
[0174] Moreover, in the piezo-electricity / electrostriction device 10B concerning the gestalt of this 2nd operation, in order for the minute variation rate of laminating mold piezo-electricity / electrostriction component 24 to be amplified by big displacement actuation using bending of the sheet metal sections 16a and 16b and to transmit to moving part 20, moving part 20 becomes possible [carrying out a variation rate greatly to the major axis m of piezo-electricity / electrostriction device 10B (referring to drawing 14)].
[0175] Moreover, in the piezo-electricity / electrostriction device 10B concerning the gestalt of this 2nd operation, since the piezo-electricity / electrostriction ingredient which be a brittle and comparatively heavy ingredient do not need to constitute all parts, a mechanical strength be high, be excellent in handling nature, shock resistance, and moisture

resistance, and have on actuation the advantage of be hard to be influence of a harmful vibration (for example, residual vibration and noise vibration at the time of a fast operation).

[0176] Moreover, when attaching a various member and various components in this piezo-electricity / electrostriction device 10B since the point of the sheet metal sections 16a and 16b of a pair is used as the open end as shown in drawing 24 , the point of the sheet metal sections 16a and 16b of said pair can be used, and as a member and components are put, they can be attached by these points. In this case, the large clamp-face product of a member or components can be taken, and the attachment nature of components can be raised. And since the member attached and components become the form included in sheet metal section 16a of a pair, and 16b, magnitude of the direction of Y of piezo-electricity / electrostriction device after attaching a member and components can be made small, and it becomes advantageous in a miniaturization.

[0177] Of course, as shown in drawing 25 , when moving part 20 is fixed between each point in the sheet metal sections 16a and 16b of a pair, a various member and various components will fix through adhesives to one principal plane of moving part 20.

[0178] Moreover, it is the location where the apical surface 208 of the multilayer object which constitutes said laminating mold piezo-electricity / electrostriction component 24 does not contain a fixed part 22 at least superficially in the gestalt of this 2nd operation. It is the location which contains a fixed part 22 at least superficially, edge 28a of an electrode 28 is a location which contains a fixed part 22 at least superficially, and he is trying for the back end side 209 of said multilayer object to form edge 30a of an electrode 30 in the location which does not contain a fixed part 22 superficially.

[0179] For example, although there is a possibility that displacement actuation of the sheet metal sections 16a and 16b of a pair may be restricted by laminating mold piezo-electricity / electrostriction component 24, and it may become impossible to obtain a big variation rate when each edge of the electrodes 28 and 30 of a pair is formed in the location included in moving part 20 With the gestalt of this 2nd operation, since it is considering as above-mentioned physical relationship, un-arranging [that displacement actuation of moving part 20 is restricted] is avoided, and the amount of displacement of the sheet metal sections 16a and 16b of a pair can be enlarged.

[0180] Next, the desirable example of a configuration of the piezo-electricity / electrostriction device 10B concerning the gestalt of the 2nd operation is explained. About the desirable example of a configuration, since it is almost the same as the piezo-electricity / electrostriction device 10A concerning the gestalt of the 1st operation mentioned above, only the desirable example of a configuration peculiar to the piezo-electricity / electrostriction device 10B concerning the gestalt of this 2nd operation is explained.

[0181] First, it sets to the piezo-electricity / electrostriction device 10B concerning the gestalt of this 2nd operation. When the configuration of this piezo-electricity / electrostriction device 10B forms not tabular [like before] but the moving part 20, Since moving part 20 and a fixed part 22 are presenting the configuration of a rectangular parallelepiped, the sheet metal sections 16a and 16b of a pair are formed so that the side face of moving part 20 and a fixed part 22 may continue, and it has rectangular cyclic structure, rigidity of Y shaft orientations of piezo-electricity / electrostriction device 10B can be alternatively made high.

[0182] That is, in this piezo-electricity / electrostriction device 10B, only actuation of the moving part 20 within a flat surface (inside of XZ flat surface) can be generated alternatively, and the actuation within YZ side of the sheet metal sections 16a and 16b of a pair (the so-called actuation of the influence direction) can be controlled.

[0183] As for the sheet metal sections 16a and 16b, it is desirable that it is a metal, and although a fixed part 22 and moving part 20 may be dissimilar materials, it is more desirable that it is a metal. Although the sheet metal sections 16a and 16b, a fixed part 22 and the sheet metal sections 16a and 16b, and moving part 20 may paste up with organic resin, low material, solder, etc., diffused junction or its integral construction made to weld is more desirable between metals. Furthermore, when the metal by which cold rolling processing was carried out is used, since many rearrangements exist, it is high intensity, and still more desirable.

[0184] Moreover, with the gestalt of this 2nd operation, since laminating mold piezo-electricity / electrostriction component 24 was formed only in one sheet metal section 16a, as shown in drawing 30 , as compared with what formed piezo-electricity / electrostriction components 24a and 24b in the sheet metal sections 16a and 16b of a pair, respectively (modification), it is cheaply producible. Furthermore, since sheet metal section 16a with large thickness in which laminating mold piezo-electricity / electrostriction component 24 was formed will displace directly and sheet metal section 16b with thin thickness in which this is interlocked with and laminating mold piezo-electricity / electrostriction component 24 is not formed will displace when it sees with the gestalt of this 2nd operation, where moving part 20 is fixed, a variation rate can be carried out more greatly.

[0185] Moreover, although formation of the laminating mold piezo-electricity / electrostriction component 24 to sheet

metal section 16a can be realized by pasting up laminating mold piezo-electricity / electrostriction component 24 on sheet metal section 16a with organic resin, low material, solder, etc., when you may make it paste up at an elevated temperature, low material, solder, glass, etc. are desirable [when making it paste up at low temperature, organic resin is desirable, and]. However, since coefficient of thermal expansion generally differs in many cases, in order to make it not make laminating mold piezo-electricity / electrostriction component 24 produce the stress by the difference of coefficient of thermal expansion, the low thing of adhesion temperature is desirable [sheet metal section 16a, the laminating mold piezo-electricity / electrostriction component 24, and adhesives 202]. If it is organic resin, since it can paste up, it will be preferably adopted in general at the temperature of 180 degrees C or less. Furthermore, it is desirable preferably to use the adhesives of a room-temperature-curing mold. Moreover, immobilization with the sheet metal sections 16a and 16b, and the piezo-electricity / electrostriction component 24 can reduce effectively distortion generated between dissimilar materials, if a fixed part 22 or moving part 20 is the structure of an open sand mold in coincidence immobilization after immobilization with a fixed part 22, moving part 20, and the sheet metal sections 16a and 16b.

[0186] In order to make it not exert thermal stress on laminating mold piezo-electricity / electrostriction component 24, organic resin performs adhesion with laminating mold piezo-electricity / electrostriction component 24, and sheet metal section 16a, and, as for immobilization of the sheet metal sections 16a and 16b, a fixed part 22, or moving part 20, it is desirable to make it another process.

[0187] Moreover, as shown in drawing 31 , when a part of laminating mold piezo-electricity / electrostriction component 24 are located in a fixed part 22, it sets. The minimum distance between the boundary parts of the boundary part with moving part 20 and fixed part 22 in the sheet metal sections 16a and 16b of a pair La, When shortest distance is set to Lb among the distance from the boundary part of moving part 20 and sheet metal section 16a to one in the electrodes 28 and 30 of the pair of laminating mold piezo-electricity / electrostriction component 24 of edge 28a or 30a, It is desirable that (1-Lb/La) is 0.4 or more, and 0.5-0.8 are more desirable. The case of 0.4 or less cannot take a large variation rate. In the case of 0.5-0.8, coexistence of a variation rate and resonance frequency tends to attain, but the thing of the structure where laminating mold piezo-electricity / electrostriction component 24 was formed only in one sheet metal section 16a in this case is more suitable. This is the same when a part of laminating mold piezo-electricity / electrostriction component 24 are located in moving part 20.

[0188] As for the total thickness of laminating mold piezo-electricity / electrostriction component 24, it is desirable to be referred to as 40 micrometers or more. It is difficult to paste up laminating mold piezo-electricity / electrostriction component 24 on sheet metal section 16a as it is less than 40 micrometers. Moreover, said total thickness has desirable 180 micrometers or less. If 180 micrometers is exceeded, the miniaturization of piezo-electricity / electrostriction device 10B will become difficult.

[0189] When using metals, such as low material and solder, as adhesives 202, as shown in drawing 28 or drawing 29 , as for the part which touches sheet metal section 16a among laminating mold piezo-electricity / electrostriction component 24, it is desirable that an electrode layer exists in the lowest layer from wettability relation. Drawing 28 and drawing 29 show the condition of having arranged the electrode layer which constitutes the electrode 30 of another side.

[0190] moreover, the laminating mold piezo-electricity / electrostriction component 24 shown in drawing 26 or drawing 28 are shown in drawing 27 or drawing 29 , when pasting sheet metal section 16a through metal layers, such as low material and solder, -- as -- the inferior surface of tongue of laminating mold piezo-electricity / electrostriction component 24 -- it is desirable to bevel the corner in which one [at least] electrode 28 exists inside. This is for preventing that the electrodes 28 and 30 of a pair short-circuit through metal layer and sheet metal section 16a. Drawing 27 shows the example which beveled two corners in which the electrodes 28 and 30 of a pair exist, and drawing 29 shows the example which beveled the corner in which one electrode 28 exists.

[0191] As adhesives 200 for pasting up adhesives 202 and the sheet metal sections 16a and 16b for pasting up laminating mold piezo-electricity / electrostriction component 24 on sheet metal section 16a on fixed part 22 grade Instantaneous adhesives, such as epoxy, reactant 2 liquid type adhesives like an isocyanate system, and a cyanoacrylate system, Although hot melt adhesive, such as an ethylene-vinylacetate copolymer, etc. is sufficient, as adhesives 202 for pasting up laminating mold piezo-electricity / electrostriction component 24 on sheet metal section 16a especially, 80 or more things have a desirable degree of hardness at Shore D.

[0192] Moreover, it is desirable to consider as the organic adhesives containing fillers, such as a metal and ceramics, as adhesives 202 on which the sheet metal sections 16a and 16b, and the laminating mold piezo-electricity / electrostriction component 24 (24a and 24b) are pasted up. In this case, as for the thickness of adhesives 202, it is desirable to make it the thickness of 100 micrometers or less. It is because the thickness of a substantial pitch becoming small and the degree

of hardness of adhesives can be kept high by making a filler contain.
[0193] As adhesives 200 and 202, inorganic adhesive besides above-mentioned organic adhesives may be used, and there are glass, cement, solder, low material, etc. as this inorganic adhesive.
[0194] On the other hand, if the configuration and the quality of the material of the sheet metal sections 16a and 16b have flexibility and have the mechanical strength of extent which is not damaged by flexion deformity, it is sufficient for them, and a metal is adopted preferably. In this case, as above-mentioned, to have flexibility and what is necessary is just the metallic material of 100 or more GPas of Young's modulus at the metallic material and concrete target which can be deformed by flexion.
[0195] Preferably, as an iron system ingredient, it is desirable to constitute from stainless steel of the martensitic stainless steel of the ferritic stainless steel of the austenitic stainless steel of SUS301, SUS304, AISI653, and SUH660 grade, SUS430, and 434 grades, SUS410, and SUS630 grade, SUS631, and AISI632 grade, such as semi austenite, maraging stainless steel, and various spring steel steel materials. Moreover, as a non-iron system ingredient, it is desirable to constitute from superelastic titanium alloys including a titanium-nickel alloy, brass, cupronickel, aluminum, a tungsten, molybdenum, beryllium copper, phosphor bronze, nickel, a ferronickel alloy, titanium, etc.
[0196] Next, some manufacture approaches for producing the piezo-electricity / electrostriction device 10B concerning the gestalt of the 2nd operation are explained, referring to drawing 32 - drawing 40 .
[0197] First, as shown in drawing 32 , the 3rd manufacture approach drills the hole 252 of the shape of a 1mm long and 8mm wide rectangle in the center section of the stainless plate 250 with a 10mm[1.6mm by] x thickness of 0.9mm, and produces the base 258 which has the cyclic structure of the rectangle matched with supporters 254 and 256 for the both sides of this hole 252, respectively.
[0198] Then, as shown in drawing 33 , the 1st stainless steel sheet metal 260 with a 10mm[1.6mm by] x thickness of 0.05mm and the 2nd stainless steel sheet metal 262 (refer to drawing 35) with a 10mm[1.6mm by] x thickness of 0.02mm are prepared.
[0199] Then, as shown in drawing 33 , adhesives 202 (for example, adhesives made of an epoxy resin) are formed in the part in which laminating mold piezo-electricity / electrostriction component 24 is formed among the top faces of the 1st stainless steel sheet metal 260 by screen-stencil. Then, as shown in drawing 34 , laminating mold piezo-electricity / electrostriction component 24 is pasted up on the 1st stainless steel sheet metal 260 through adhesives 202.
[0200] Then, as shown in drawing 35 , adhesives 200 (for example, adhesives made of an epoxy resin) are formed by screen-stencil on each supporter 254 of a base 258, and 256.
[0201] Then, adhesives 200 are minded on one field of each supporters 254 and 256. The 1st stainless steel sheet metal 260 with which said laminating mold piezo-electricity / electrostriction component 24 are already formed is pasted up. The 2nd stainless steel sheet metal 262 is pasted up through adhesives 200 on the field of another side of each supporters 254 and 256, and the device original recording 270 which pressurizes in the direction which sandwiches a base 258 and shows these [1st] and the 2nd stainless steel sheet metal 260 and 262 further to drawing 36 is produced. In addition, welding pressure is 0.1 - 10 kgf/cm2.
[0202] Then, as shown in drawing 36 , the device original recording 270 is cut in the part of a cutting plane line 272, and it separates into each piezo-electricity / electrostriction device 10B as shown in drawing 25 . This cutting processing was performed using 0.1mm of wire sizes, and a wire saw with a spacing of 0.2mm. Although ingredients differ by using a wire saw, respectively, the width of face of adhesives 200 and 202 can be specified in the width-of-face list of the width of face of laminating mold piezo-electricity / electrostriction component 24, and sheet metal section 16a almost identically.
[0203] Next, as shown in drawing 37 , the 4th manufacture approach drills the hole 252 of the shape of a 1mm long and 8mm wide rectangle in the center section of the stainless plate 250 with a 10mm[1.6mm by] x thickness of 0.9mm, and produces the base 258 which has the cyclic structure of the rectangle matched with supporters 254 and 256 for the both sides of this hole 252, respectively.
[0204] Then, adhesives 200 (for example, adhesives made of an epoxy resin) are formed by screen-stencil on each supporter 254 of a base 258, and 256.
[0205] Then, as shown in drawing 38 , the 1st stainless steel sheet metal 260 with a 10mm[1.6mm by] x thickness of 0.05mm is pasted up through adhesives 200 on one field of each supporters 254 and 256. The 2nd stainless steel sheet metal 262 with a 10mm[1.6mm by] x thickness of 0.02mm is pasted up through adhesives 200 on the field of another side of each supporters 254 and 256, and these [1st] and the 2nd stainless steel sheet metal 260 and 262 are further pressurized in the direction which sandwiches a base 258. In addition, welding pressure is 0.1 - 10 kgf/cm2.
[0206] Then, adhesives 202 (for example, adhesives made of an epoxy resin) are formed in the part in which laminating mold piezo-electricity / electrostriction component 24 is formed among the top faces of the 1st stainless steel sheet

metal 260 by screen-stencil.
[0207] Then, as shown in drawing 40 , laminating mold piezo-electricity / electrostriction component 24 is pasted up on the 1st stainless steel sheet metal 260 through adhesives 202, and the device original recording 270 is produced.
[0208] Then, as shown in drawing 36 , the device original recording 270 is cut in the part of a cutting plane line 272, and it separates into each piezo-electricity / electrostriction device 10B as shown in drawing 25 .
[0209] When a part of piezo-electricity / electrostriction device 10B (for example, fixed part 22) produced by these [3rd] and the 4th manufacture approach were fixed, bias voltage 15V and sinusoidal-voltage**15V were impressed between the electrode 28 of the pair of laminating mold piezo-electricity / electrostriction component 24, and 30 and the variation rate of moving part 20 was measured, it was **1.2 micrometers. Moreover, it was 50kHz when the lowest resonance frequency which carries out the sweep of the frequency and shows the max of a variation rate as sinusoidal-voltage**0.5V was measured.
[0210] Although considered as the cyclic structure of the rectangle which has the supporter 254 which turns into moving part 20 behind, and the supporter 256 which turns into a fixed part 22 behind as a configuration of a base 258 by the above-mentioned 3rd and the 4th manufacture approach In addition, a hole 252 is made large as shown in drawing 41 . It is good for partial 254a (part which specifies substantially the thickness of the part between which moving part 20 intervenes behind at least) of the shape of a frame which supports the 1st and 2nd stainless steel sheet metal 260 and 262, and the back also as cyclic structure of the rectangle which has the supporter 256 used as a fixed part 22.
[0211] In this case, by producing the same device original recording 270 as what fixes through adhesives 200 and is shown in drawing 36 so that a base 258 may be inserted with the 1st and 2nd stainless steel sheet metal 260 and 262, and cutting further along with the cutting plane line 272 as shown by drawing 36 , as shown in drawing 44 , the piezo-electricity / electrostriction device 10B to which moving part 20 does not exist between the points of the sheet metal sections 16a and 16b are producible.
[0212] Next, it explains, referring to drawing 42 - drawing 46 about the 5th different manufacture approach from the 3rd and 4th manufacture approaches mentioned above.
[0213] This 5th manufacture approach like the 3rd and 4th manufacture approaches mentioned above Paste up supporters 254 and 256 on the 1st stainless steel sheet metal 260 and the 2nd stainless steel sheet metal 262, and the device original recording 270 is produced. Then, can apply, also when separating into each piezo-electricity / electrostriction device 10B, and The unit by which separation formation was carried out in each actuator section 204 which comes to form laminating mold piezo-electricity / electrostriction components 24a and 24b in the sheet metal sections 16a and 16b It can apply, also when producing piezo-electricity / electrostriction device 10B by fixing the fixed part 22 (and suitably moving part 20) prepared by dissociating similarly.
[0214] Later, by the following explanation, moving part 20 is described as "moving part 20" for convenience in the supporter 254 list which serves as moving part 20, and a fixed part 22 is described as "a fixed part 22" for convenience by it in the supporter 256 list which serves as a fixed part 22 behind, and it describes the sheet metal sections 16a and 16b for convenience "the sheet metal sections 16a and 16b" at the 1st and 2nd stainless steel sheet metal 260 and 262 lists which serve as the sheet metal sections 16a and 16b behind.
[0215] And when using adhesives with a fluidity in case the sheet metal sections 16a and 16b are pasted up on a fixed part 22 and moving part 20 through adhesives 200 as shown in drawing 42 , in order to specify the formation location of adhesives 200, it is desirable to prepare 280bm(s) and 280bn(s) in each sheet metal section 16a list in level difference 280am and a 280an list at 16b. Of course, when using viscous high adhesives, it is not necessary to prepare such a level difference. In addition, 280bm(s) and 280bn(s) may be formed in level difference 280am and a 280an list by the laminating of a tabular object.
[0216] Drawing 43 considers as fluid high adhesives as adhesives 200 used for adhesion with moving part 20 and each sheet metal sections 16a and 16b, it is the case where viscous high adhesives are used as adhesives 200 used for adhesion with a fixed part 22 and each sheet metal sections 16a and 16b, and the example which prepared level difference 280an and 280bn(s) in the part using fluid high adhesives among the sheet metal sections 16a and 16b is shown.
[0217] Drawing 44 shows the case where viscous high adhesives are used as adhesives 200 used for adhesion with a fixed part 22 and the sheet metal sections 16a and 16b, and shows the structure where 280bm(s) and 280bn(s) are not prepared in the above level difference 280am(s) and 280an lists.
[0218] Drawing 45 is the case where the high adhesives of both fluidities are used as adhesives 200 used for adhesion with a fixed part 22 and moving part 20, and the sheet metal sections 16a and 16b, and shows the example which prepared 282bm(s) and 282bn(s) in projection 282am and the 282an list for dividing the formation field of adhesives 200 in a sheet metal section 16a list especially at 16b.

[0219] In the example shown in drawing 42 as shown in drawing 46 The magnitude of a fixed part 22 and moving part 20, Level difference 280am of the sheet metal sections 16a and 16b in a fixed part 22 and 280bm(s), and area of the field which counters are especially made larger than the area of level difference 280am and 280bm(s). It may be made to make area of level difference 280an of the sheet metal sections 16a and 16b in moving part 20 and 280bn(s), and the field that counters larger than the area of level difference 280am and 280bm(s). Thereby, level difference 280am and 280bm(s) can prescribe a substantial drive part (it is a part between level difference 280bm and 280bn(s) to the partial list between level difference 280am and 280an(s)) among the sheet metal sections 16a and 16b. As shown in drawing 42 , area of level difference 280am of each sheet metal sections 16a and 16b in a fixed part 22 and 280bm(s), and the field that counters is made almost the same as the area of level difference 280am and 280bm(s). When area of level difference 280an of each sheet metal sections 16a and 16b in moving part 20 and 280bn(s), and the field that counters is made almost the same as the area of level difference 280an and 280bn(s) A possibility that dispersion in magnitude with moving part 20, level difference 280an, and 280bn(s) may influence the die length of said substantial drive part is in the dispersion list of magnitude with a fixed part 22, level difference 280am, and 280bm(s). In addition, although drawing 46 showed the example which turned the fixed part 22 to moving part 20, and enlarged it, it may be made to enlarge the direction of said moving part 20 towards the method of the outside which is an opposite direction. This is the same also in moving part 20.

[0220] In drawing 42 - drawing 46 , although level difference 280am, 280bm, 280an and 280bn(s), projection 282am, 282bm, 282an and 282bn(s), and the sheet metal sections 16a and 16b are unifying, like drawing 19 or drawing 23 , through adhesives, the laminating of the plate processed suitably may be carried out, and it may be formed. It unifies, and when preparing, while forming the sheet metal sections 16a and 16b by making a plate member thin by etching, cutting, etc., said level difference 280am, 280bm, 280an and 280bn(s), and projection 282am, 282bm, 282an and 282bn (s) can be prepared in one.

[0221] In addition, although the above-mentioned example showed the example which formed adhesives 200 and 202 by screen-stencil, dipping, a dispenser, an imprint, etc. can be used.

[0222] Next, it explains, referring to drawing 47 - drawing 52 about various examples of a configuration about the adhesives 200 by which it is placed between the adhesives 202 lists which intervene, for example between sheet metal section 16a, and the laminating mold piezo-electricity / electrostriction component 24 between the sheet metal sections 16a and 16b, moving part 20, and a fixed part 22.

[0223] First, in the 1st technique shown in drawing 47 , laminating mold piezo-electricity / electrostriction component 24 is pasted up on the part in which many holes 290 were formed in sheet metal section 16a, and these holes 290 were formed through adhesives 202. In this case, since adhesives 202 enter in a hole 290, while adhesion area becomes large substantially, it becomes possible to make thickness of adhesives 202 thin. It is desirable that it is 5% or less of the total thickness of laminating mold piezo-electricity / electrostriction component 24, and is more than the thickness of extent which can absorb the heat stress by the difference of the coefficient of thermal expansion of sheet metal section 16a and adhesives 202 as thickness of said adhesives 202.

[0224] As a path of a hole 290, 5 micrometers - 100 micrometers may be desirable, and staggered arrangement is [a matrix-like is sufficient as the array pattern, and] sufficient as it. Of course, one train may be made to arrange two or more holes 290. As an array pitch of a hole 290, 10 micrometers - 200 micrometers are desirable. Moreover, you may be a crevice (hole) instead of a hole 290. In this case, the path of a hole may have 5 micrometers - desirable 100 micrometers, and staggered arrangement is [a matrix-like is sufficient as that array pattern, and] sufficient as it. As an array pitch of a hole, 10 micrometers - 200 micrometers are desirable. Especially in the case of a crevice (hole), it is made into the shape for example, of a flat-surface rectangle, and it may be made to make the opening area smaller than the projected area to sheet metal section 16a of laminating mold piezo-electricity / electrostriction component 24 slightly. In addition, as the technique of forming a hole 290 and a hole in sheet metal section 16a, etching, laser beam machining, blanking, drilling, an electron discharge method, ultrasonic machining, etc. are employable, for example.

[0225] In the 2nd technique shown in drawing 48 , the front face 292 of a part in which laminating mold piezo-electricity / electrostriction component 24 is formed among sheet metal section 16a is made coarse by blasting processing, etching processing, or plating processing. In this case, the inferior surface of tongue 294 of laminating mold piezo-electricity / electrostriction component 24 is also made coarse. Thereby, since adhesion area becomes large substantially, it becomes possible to make thickness of adhesives 202 thin.

[0226] Although drawing 48 showed the example which made coarse the front face of sheet metal section 16a, and the inferior surface of tongue (sheet metal section 16a and field which counters) of laminating mold piezo-electricity / electrostriction component 24, it is [that adhesive strength with adhesives 202 should just make the field of the smaller one coarse] also fully effective to have made coarse only the front face of sheet metal section 16a. As surface

roughness, when it sees, for example by the center line average of roughness height, Ra=0.1micrometer-5micrometer is desirable and is 0.3 micrometers - 2 micrometers more preferably.
[0227] Curvature 296 is given to the flash configuration of adhesives 200, and the flash configuration of the adhesives 200 to the hole (hole 252 of a base 258) especially formed in the wall of the sheet metal sections 16a and 16b, wall of moving part 20 20a, and wall 22a of a fixed part 22 in the 3rd technique shown in drawing 49 . In this case, it is desirable to set radius of curvature to 0.05mm or more, and for a flash configuration to become straight line-like, or to make it a straight-line part included. Formation of the curvature 296 to said flash part of adhesives 200 can be realized before hardening of adhesives 200 by making the core of the shape for example, of a cylinder insert in a hole 252. It controls by the physical properties of adhesives 200, and coverage, and is made for a flash configuration not to turn into convex at least in fact.
[0228] Thereby, since the wall of each sheet metal sections 16a and 16b is also used for the wall 22a list of wall 20a of moving part 20, or a fixed part 22 as an adhesion side, adhesion area becomes large and bond strength can be enlarged. Moreover, the stress concentration for the joint (corner) of wall 22a of a fixed part 22 and the wall of each sheet metal sections 16a and 16b can be distributed effectively.
[0229] The 4th technique shown in drawing 50 is beveling the corner which counters with moving part 20 among the corners of moving part 20 among the corners of a fixed part 22, the corner which counters, and/or a fixed part 22, respectively, and considering as the taper side 298. By adjusting the include angle and radius of curvature of beveling suitably, the amount of flashes of adhesives 200 can be stabilized, local dispersion of bond strength can be controlled, and improvement in the yield can be aimed at.
[0230] What grinding and polish are performed in advance to the part which serves as one supporter 254 and said corner of the supporter 256 of another side before assembly, and is considered as the taper side 298 as an approach of beveling said corner, for example is desirable. Of course, said beveling may be performed after assembly. In this case, laser beam machining, ultrasonic machining, sandblasting, etc. are adopted preferably.
[0231] In case the 5th technique shown in drawing 51 produces the sheet metal sections 16a and 16b, although blanking processing is performed, a burr 300 will usually occur in this case. Although you may make it remove the generated burr 300 before assembly, you may make it leave as it is. In that case, it is desirable to specify the direction of the burr 300 to generate in consideration of the ease of the control to the adhesion direction of handling or each part material and the amount of adhesives etc. The example of drawing 51 shows the condition of having turned the burr 300 of the sheet metal sections 16a and 16b to the method of outside.
[0232] The 6th technique shown in drawing 52 makes thickness of one sheet metal section 16a larger than the thickness of sheet metal section 16b of another side, as mentioned above. And when using it for actuator section 204 list as a sensor, it is desirable to form laminating mold piezo-electricity / electrostriction component 24 on one sheet metal section 16a.
[0233] In addition, in case laminating mold piezo-electricity / electrostriction component 24 is pasted up on the sheet metal sections 16a and 16b through adhesives 202 as the other technique, for example, you may make it make for example, ZrO two-layer placed between the inferior surfaces of tongue of laminating mold piezo-electricity / electrostriction component 24 as a substrate layer.
[0234] Moreover, when using stainless steel sheet metal 260 and 262 (reference, such as drawing 33) as the sheet metal sections 16a and 16b, it is desirable to make it mostly in agreement [the longitudinal direction of the sheet metal sections 16a and 16b and the cold rolling direction of stainless steel sheet metal 260 and 262].
[0235] In addition, as for piezo-electricity / three layers - about ten layers of electrostriction layers 26 which constitute laminating mold piezo-electricity / electrostriction component 24, it is desirable to carry out a laminating.
[0236] According to the piezo-electricity / the electrostriction devices 10A and 10B which were mentioned above, various transducers, Various actuators, a frequency-domain functional part (filter), a transformer, Others [active elements /, such as an object for a communication link, a trembler for power, a resonator, a radiator, and a discriminator], It can use as sensor components for [various] sensors, such as an ultrasonic sensor, an acceleration sensor and an angular-velocity sensor, and an impact sensor, a mass sensor. It can use suitable for the various actuators especially used for the variation rate of various precision components, such as an optical instrument and a precision mechanical equipment, etc., or the device of positioning adjustment and include-angle adjustment.
[0237] In addition, the piezo-electricity / electrostriction device concerning this invention, and its manufacture approach of the ability of various configurations to be taken are natural, without deviating not only from the gestalt of above-mentioned operation but from the summary of this invention.
[0238]
[Effect of the Invention] As explained above, according to the piezo-electricity / electrostriction device concerning this

invention, and its manufacture approach While being able to raise the attachment nature of the components to moving part, or the stability of piezo-electricity / electrostriction device in the reinforcement of piezo-electricity / electrostriction device, and a handling nature list and being able to carry out the variation rate of the moving part greatly by the low battery relatively by this Can make improvement in the speed (raise in resonance frequency) of piezo-electricity / electrostriction device, especially displacement actuation of moving part attain, moreover, are hard to be influenced of a harmful vibration, and a high-speed response is possible. A mechanical strength is high and the displacement component excellent in handling nature, shock resistance, and moisture resistance and the sensor component which can detect vibration of moving part with a sufficient precision in a list can be obtained.

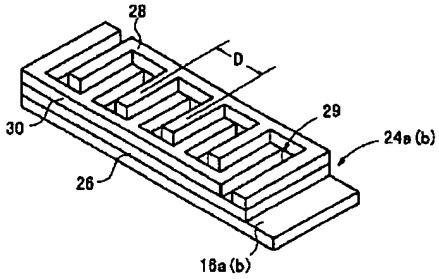
[Translation done.]

* NOTICES *

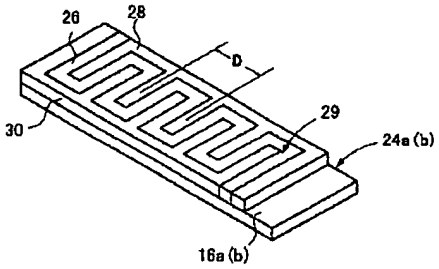
1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

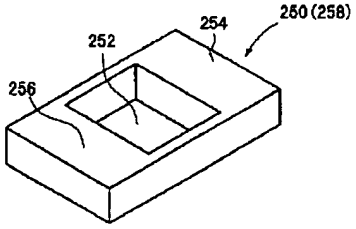
[Drawing 10]
FIG. 10



[Drawing 11]
FIG. 11

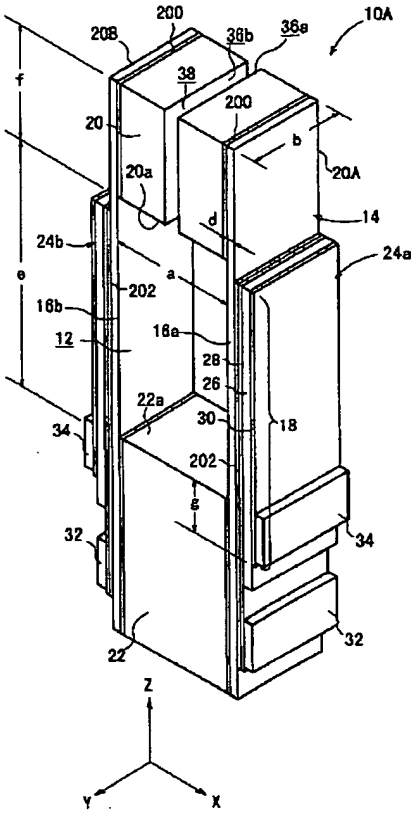


[Drawing 32]
FIG. 32



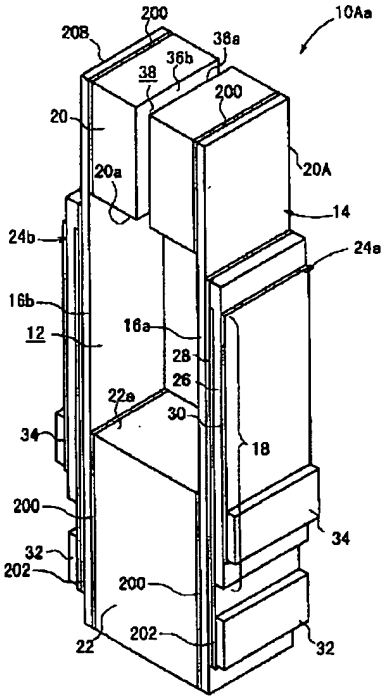
[Drawing 1]

FIG. 1



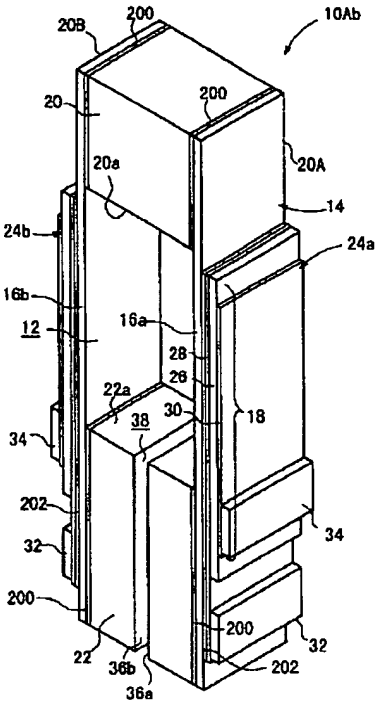
[Drawing 2]

FIG. 2



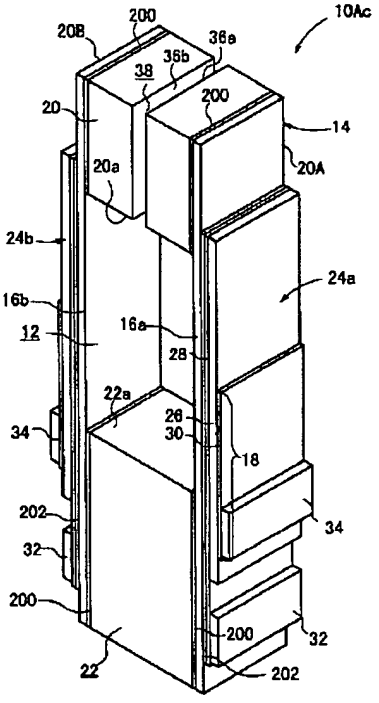
[Drawing 3]

FIG. 3



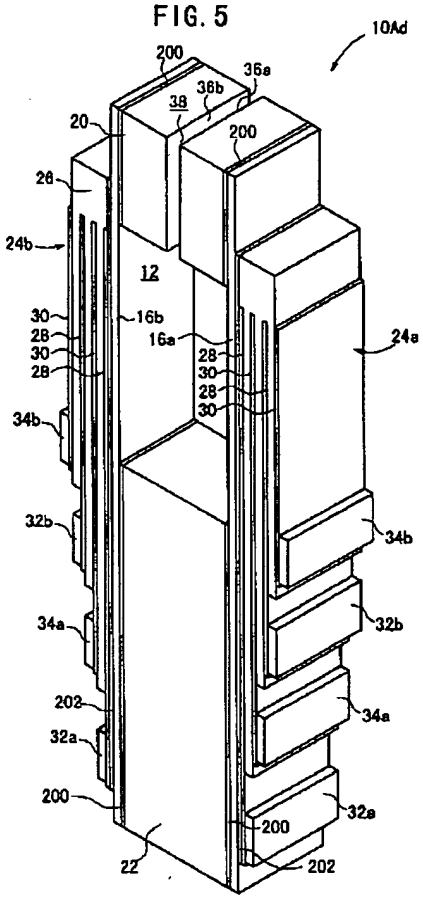
[Drawing 4]

FIG. 4



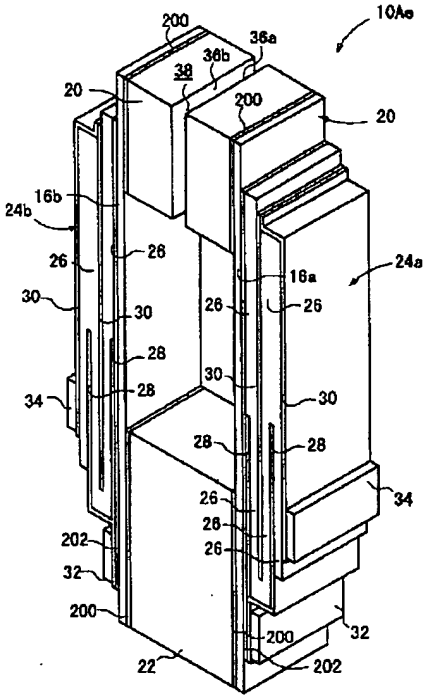
[Drawing 5]

FIG. 5



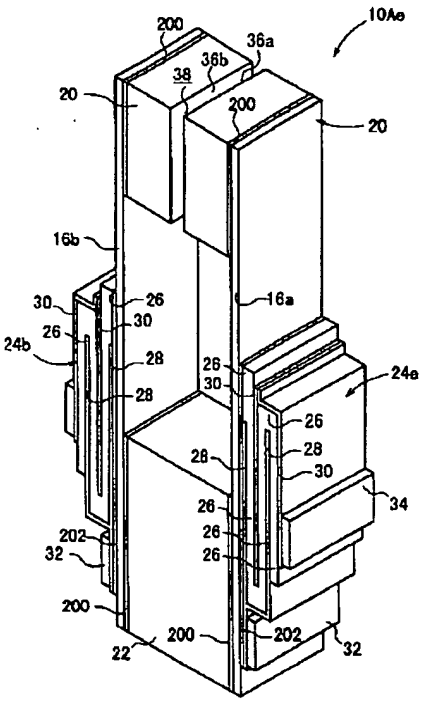
[Drawing 6]

FIG. 6



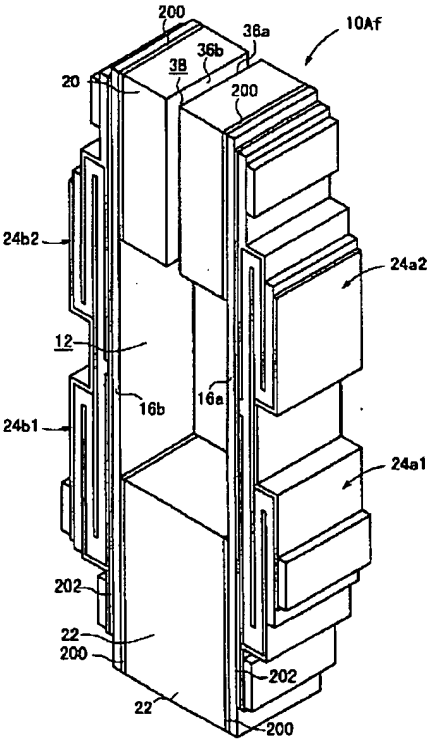
[Drawing 7]

FIG. 7



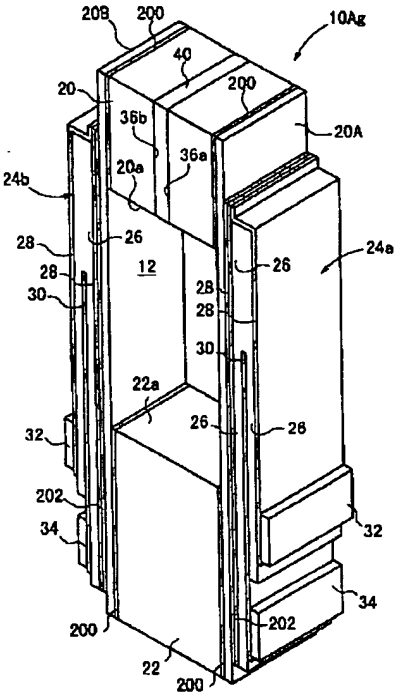
[Drawing 8]

FIG. 8



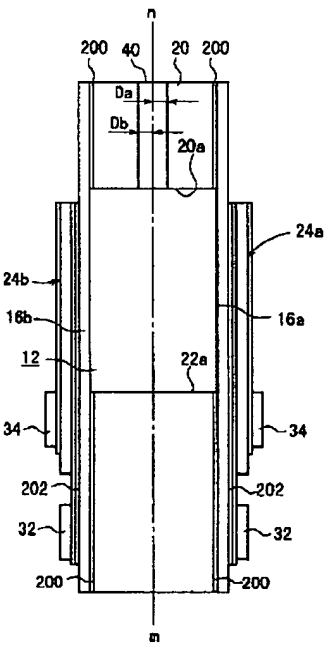
[Drawing 9]

FIG. 9



[Drawing 12]

FIG. 12



[Drawing 13]

FIG. 13A

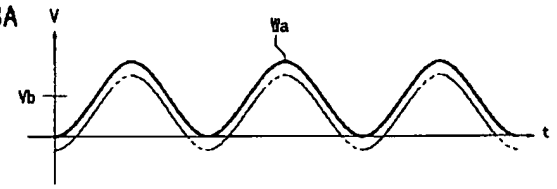
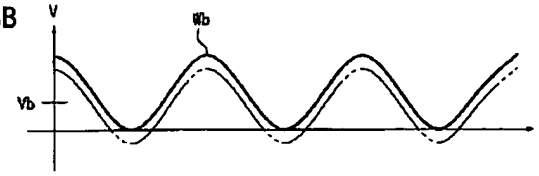
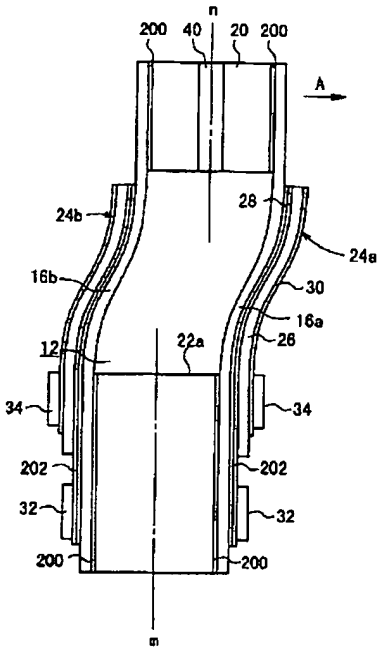


FIG. 13B



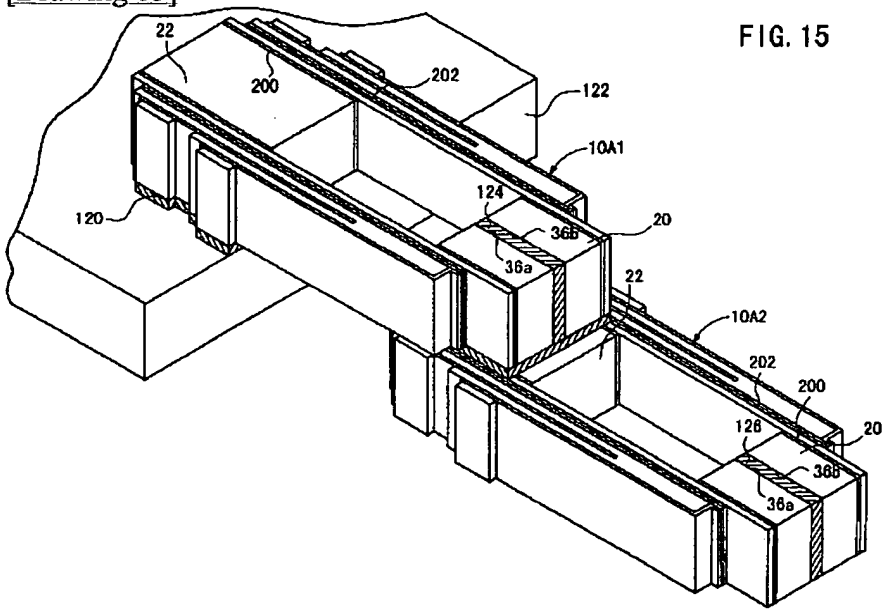
[Drawing 14]

FIG. 14



[Drawing 15]

FIG. 15



[Drawing 16]

FIG. 16A

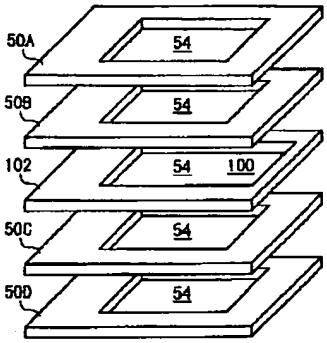
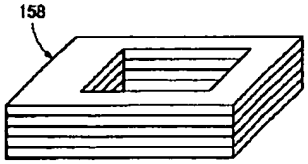
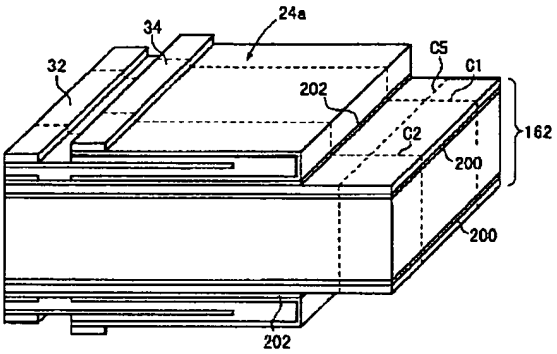


FIG. 16B



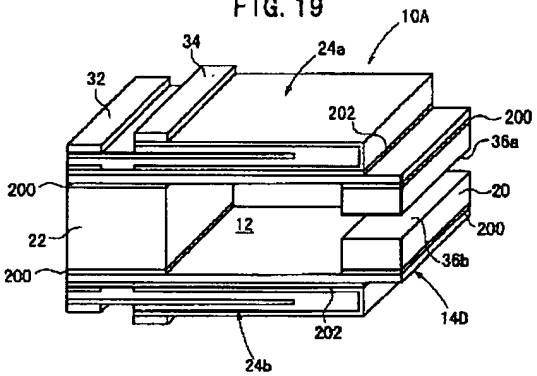
[Drawing 18]

FIG. 18



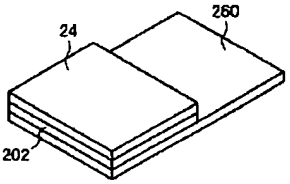
[Drawing 19]

FIG. 19



[Drawing 34]

FIG. 34



[Drawing 17]

FIG. 17A

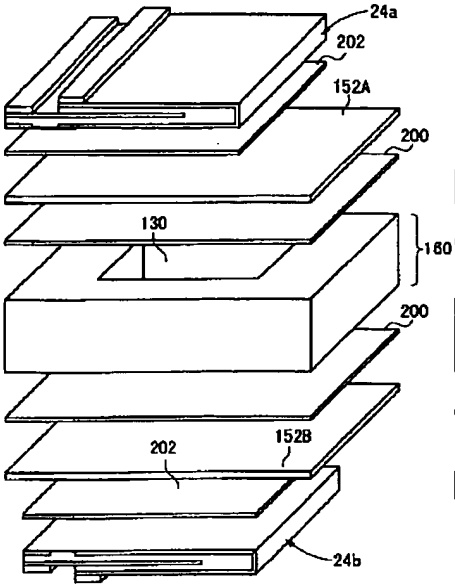
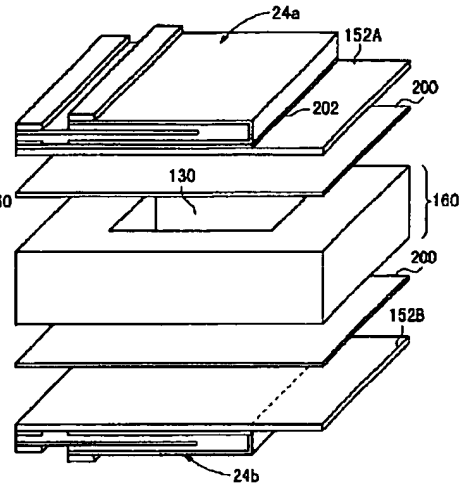


FIG. 17B



[Drawing 20]

FIG. 20A

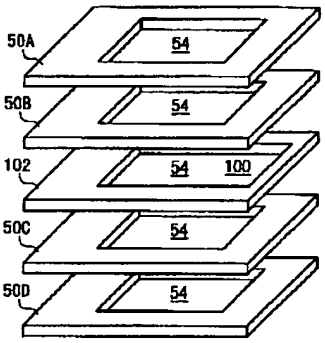
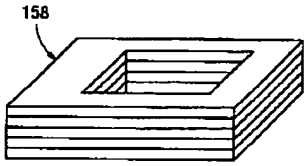
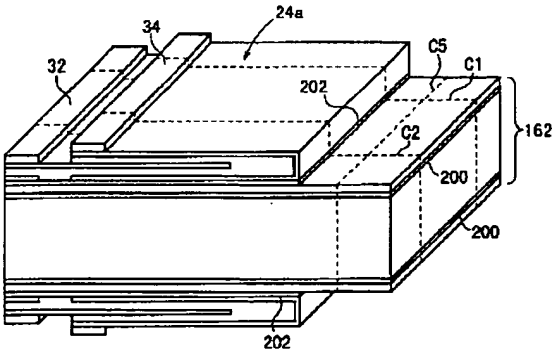


FIG. 20B



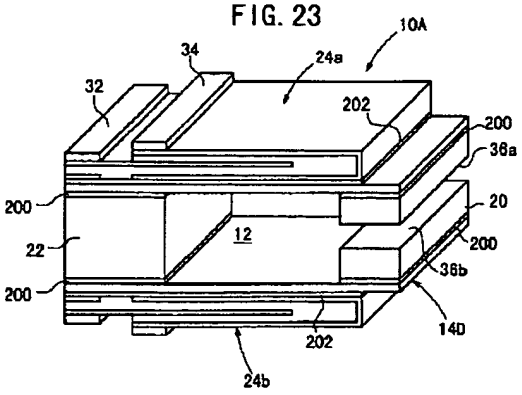
[Drawing 22]

FIG. 22



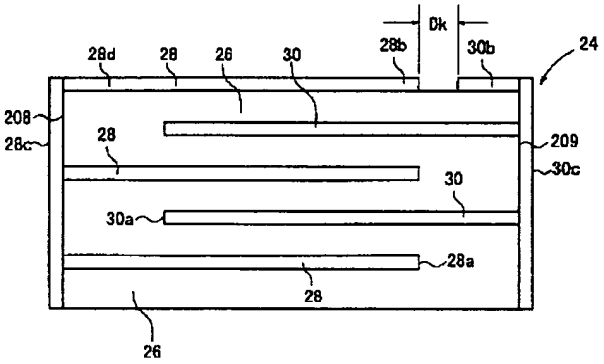
[Drawing 23]

FIG. 23



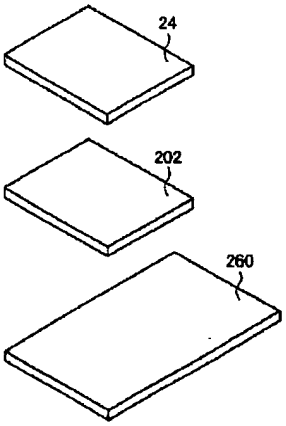
[Drawing 26]

FIG. 26



[Drawing 33]

FIG. 33



[Drawing 21]

FIG. 21A

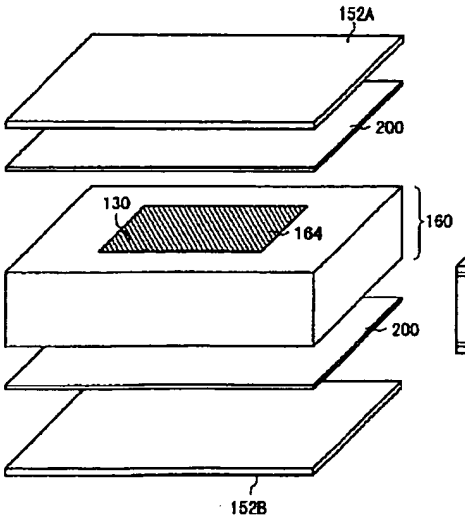
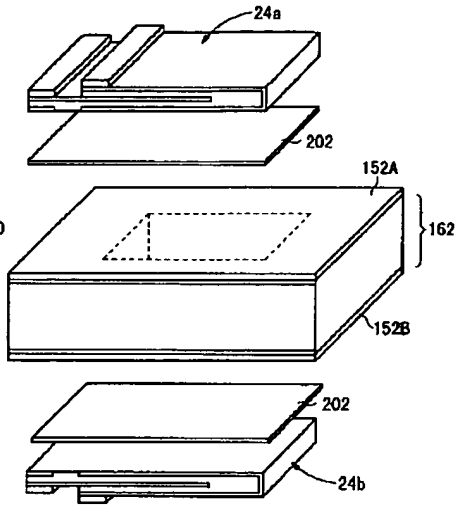
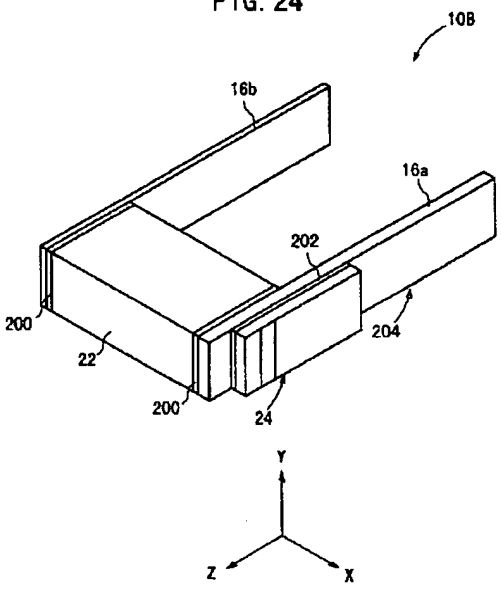


FIG. 21B



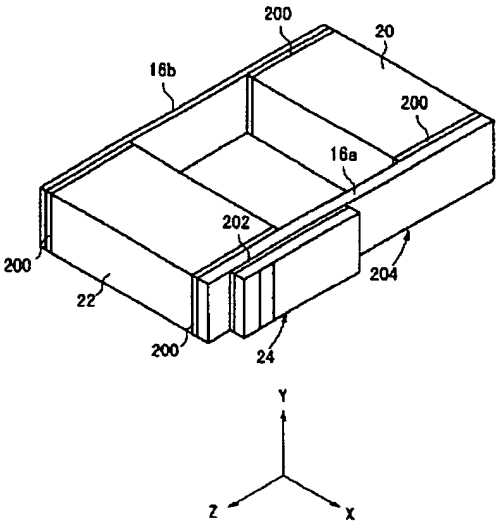
[Drawing 24]

FIG. 24



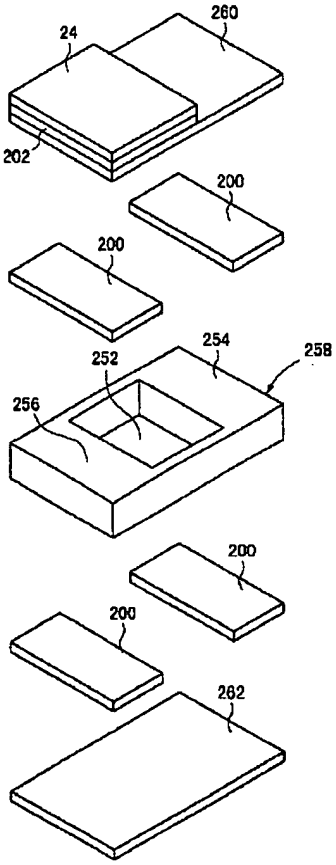
[Drawing 25]

FIG. 25



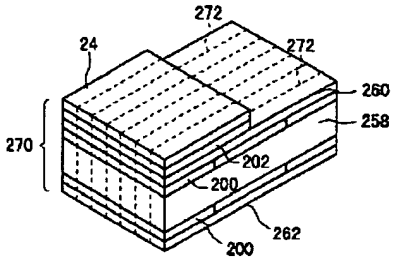
[Drawing 35]

FIG. 35



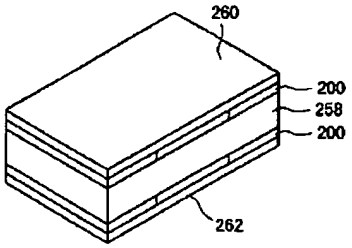
[Drawing 36]

FIG. 36



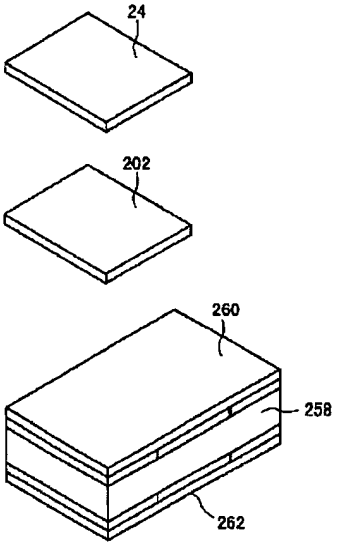
[Drawing 38]

FIG. 38



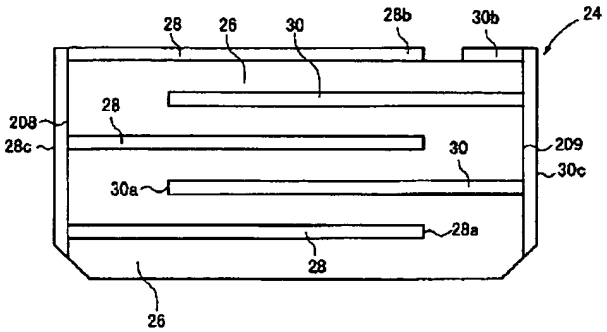
[Drawing 39]

FIG. 39



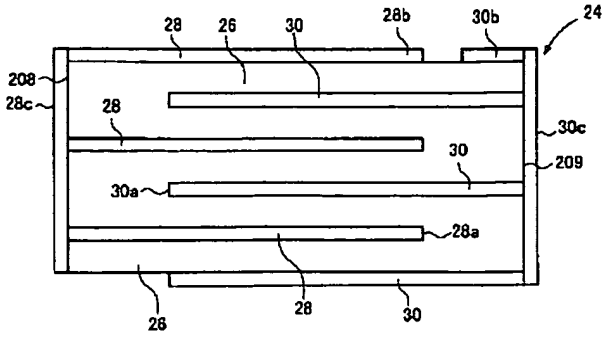
[Drawing 27]

FIG. 27



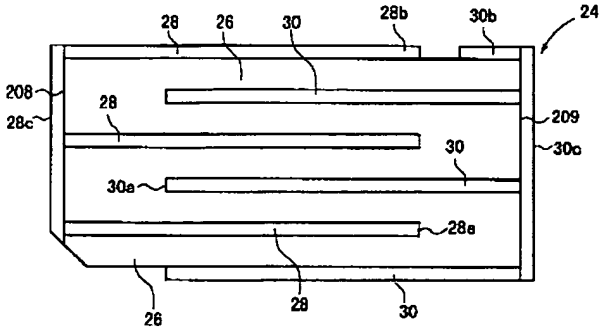
[Drawing 28]

FIG. 28



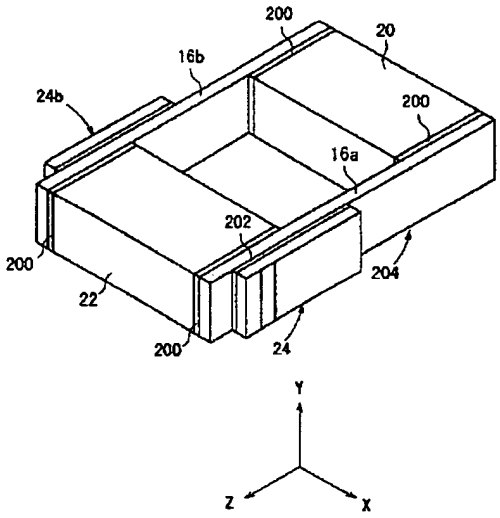
[Drawing 29]

FIG. 29



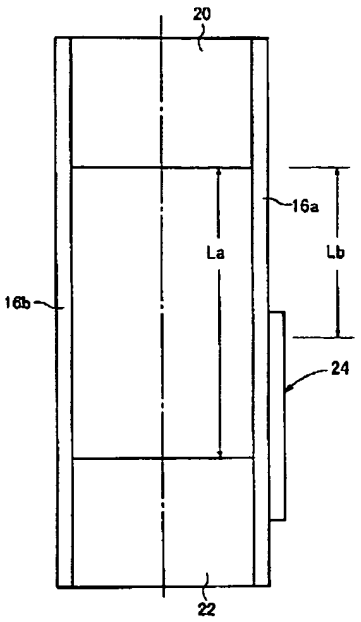
[Drawing 30]

FIG. 30



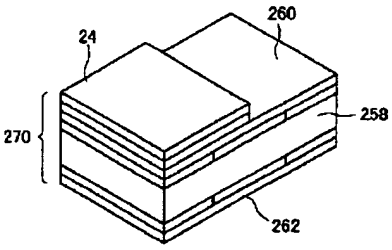
[Drawing 31]

FIG. 31



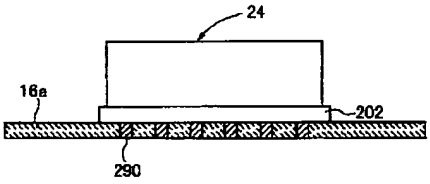
[Drawing 40]

FIG. 40



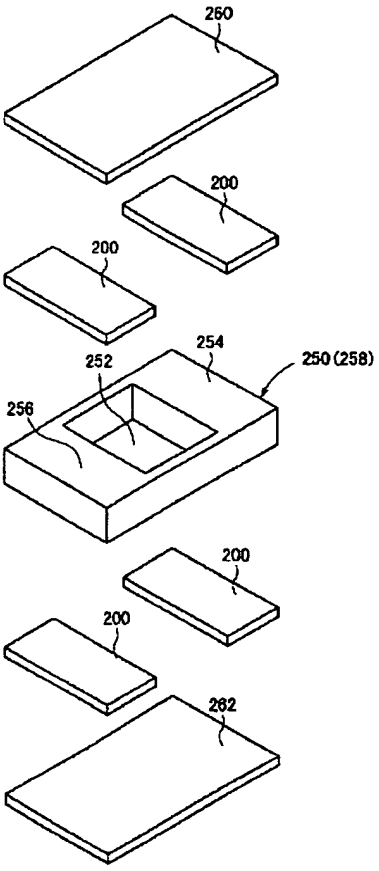
[Drawing 47]

FIG. 47



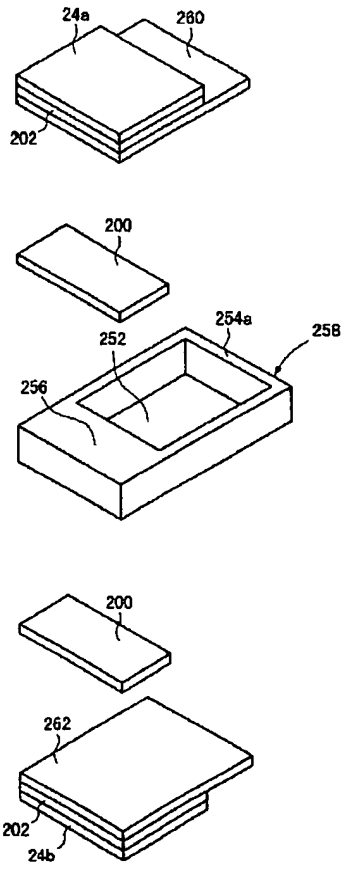
[Drawing 37]

FIG. 37



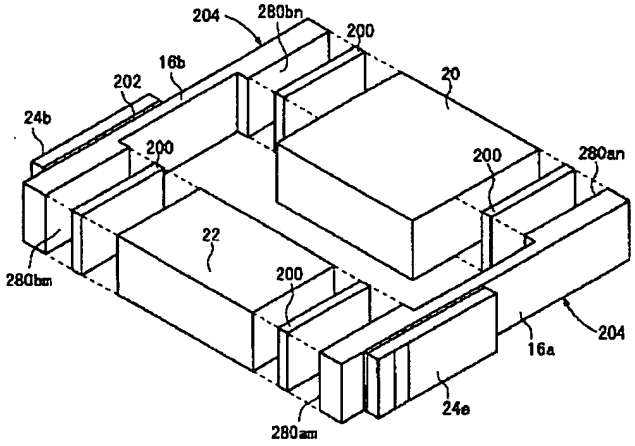
[Drawing 41]

FIG. 41



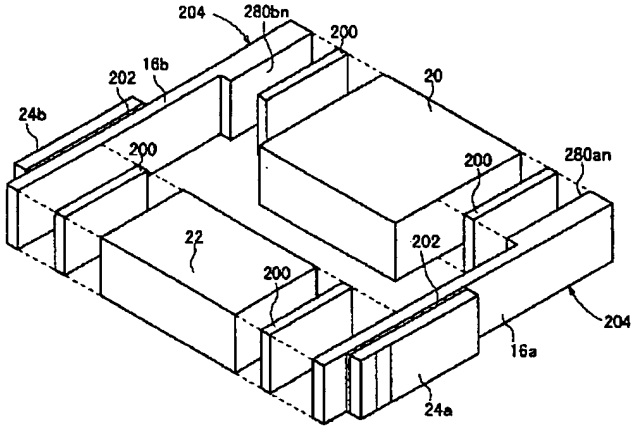
[Drawing 42]

FIG. 42



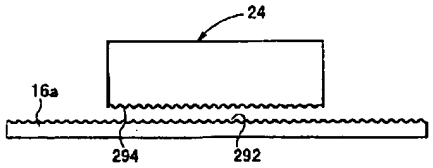
[Drawing 43]

FIG. 43



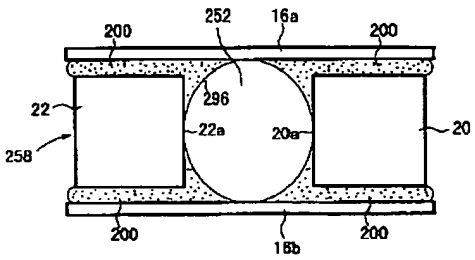
[Drawing 48]

FIG. 48



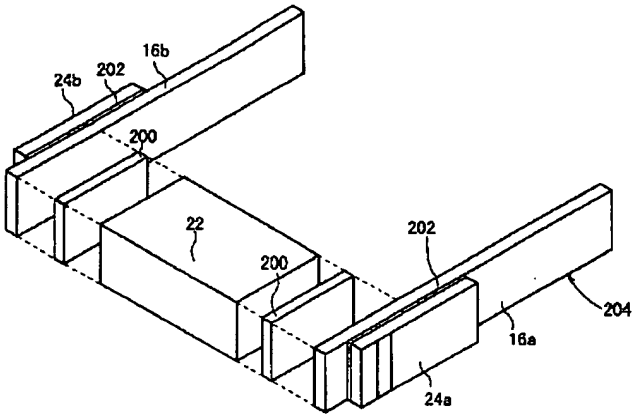
[Drawing 49]

FIG. 49



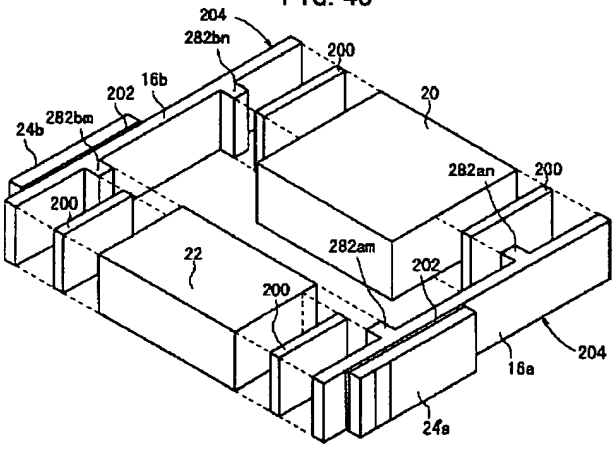
[Drawing 44]

FIG. 44



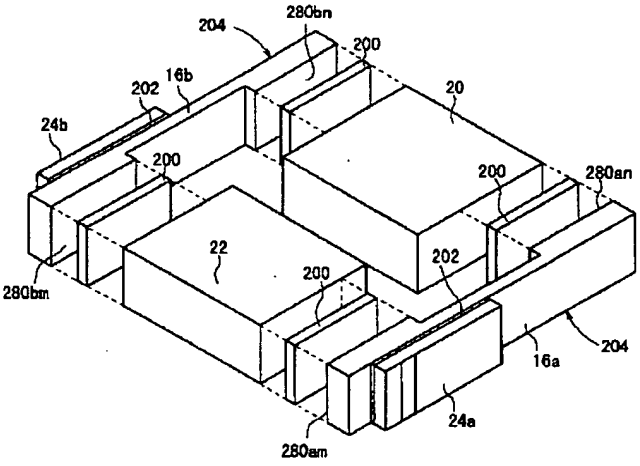
[Drawing 45]

FIG. 45



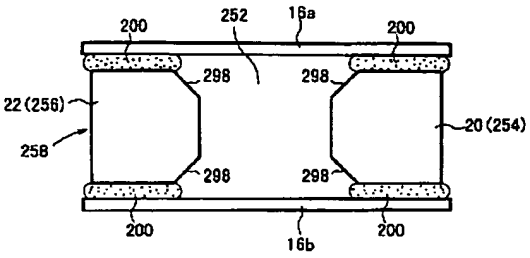
[Drawing 46]

FIG. 46



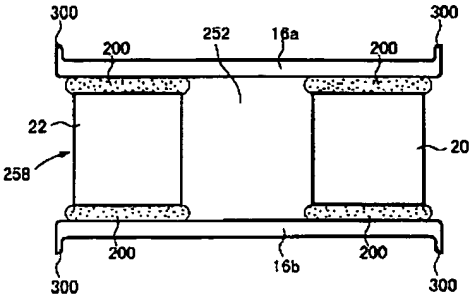
[Drawing 50]

FIG. 50



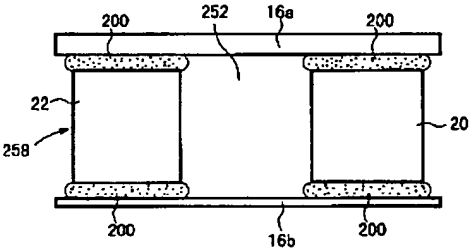
[Drawing 51]

FIG. 51



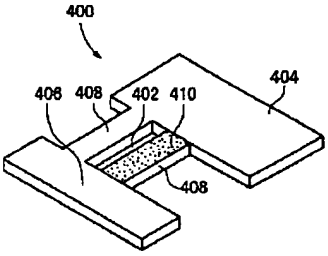
[Drawing 52]

FIG. 52



[Drawing 53]

FIG. 53



[Translation done.]